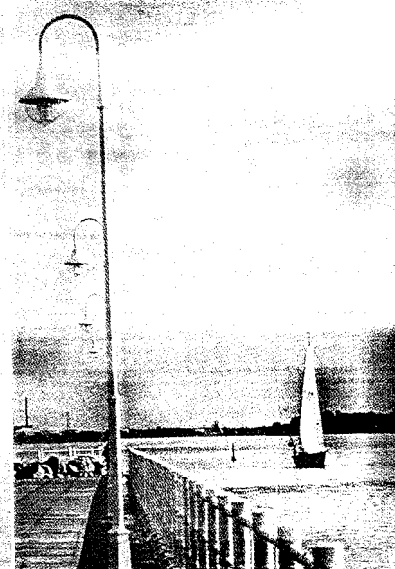


St. Clair River and Lake Huron

# Water Use Goals Remedial Measures and Implementation Strategy



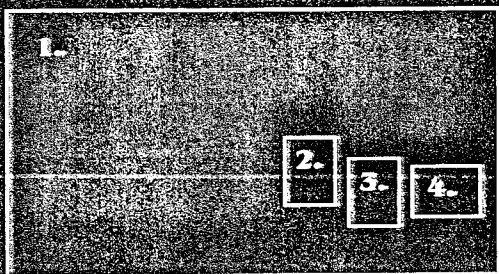
Canada Ontario

Remedial Action Plan  
Plan d'assainissement



DNR

Michigan Department of Natural Resources  
Surface Water Quality Division



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taken by:**

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Photographs appearing in this publication are selected from entries to the annual St. Clair River Photo Contest as well as from the files of MOEE field personnel. These pictures reflect the beauty, diversity and importance of the St. Clair River to all who use it.

For more information on the St. Clair River Remedial Action Plan, contact the Ontario Ministry of the Environment and Energy at 519-536-4030; or the Michigan Department of Natural Resources at 517-535-6970; or write to: St. Clair River RAP, P.O. Box 2405, Sarnia, Ontario N7T 7S6.



*The St. Clair River Area of Concern*

**Water Use Goals**

**Remedial Measures and  
Implementation Strategy**

**Remedial Action Plan**

**Stage 2 – Recommended Plan**

**St. Clair River RAP Team**

**St. Clair River BPAC**

**March 7, 1995**

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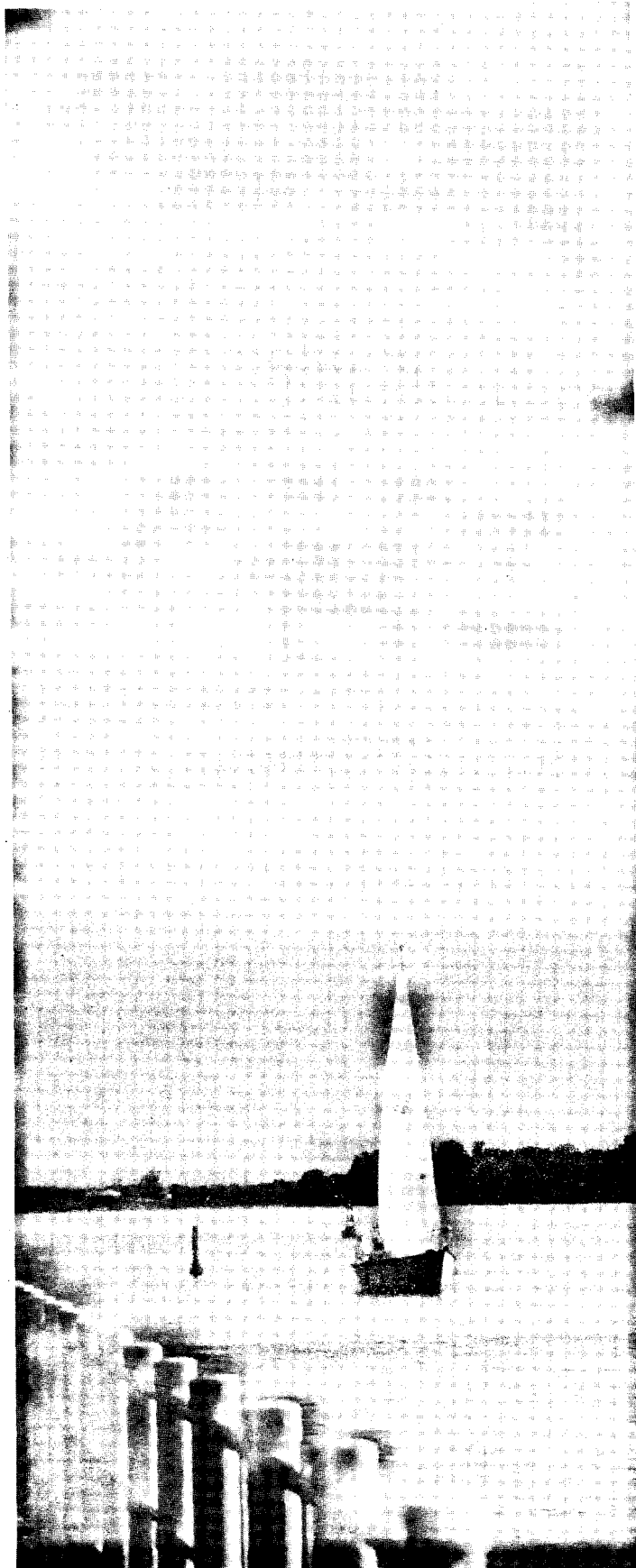
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Canada-Ontario Agreement Respecting Great Lakes Water Quality  
L'Accord Canada-Ontario relatif à la qualité de l'eau dans les Grands Lacs



**P**reparation of the Stage 2 Recommended Plan, herein referred to as the Stage 2 Remedial Action Plan (RAP), for the St. Clair River has involved the dedication and expertise of many individuals, particularly volunteers, from both within and outside of the St. Clair River Area of Concern (AOC). Stage 2 marked the establishment of a new working relationship between members of the Binational Public Advisory Council (BPAC) and government agency members on the RAP team. The process, involving facilitated task teams and strategically timed workshops was successful in identifying goals, priorities and recommended actions to correct environmental problems outlined in Stage 1 of the RAP.

Stage 2 has followed a locally prescribed "ecosystem approach" recognizing the St. Clair River and its watershed as an entity without regard for geo-political borders and establishing priorities based on environmental quality needs. This "international" RAP has been a model of cooperation largely the result of a forward thinking and active BPAC who have, on several occasions, overcome international borders and roadblocks to maintain a productive process. BPAC and the RAP team have communicated successes and failures to other international RAPs through numerous engagements hosted or attended by members including an IJC sponsored international RAP roundtable. The participants learned from difficulties and delays encountered during the development of Stage 1 and have through diligence kept on time despite an ambitious schedule. In addition, there have been many examples of partnerships established to secure grants and private or agency funding for work which could have otherwise not been completed.

The following BPAC and RAP Team members, invited experts, facilitators and technical writers have enabled the completion of a Stage 2 report which is challenging yet achievable and supported by all involved:

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|-------------------------------------------------------------------|-----|--------------------------------------------------------------------------------------|----|
| FOREWORD .....                                                    | ii  | 4.1.1 Ontario and Canada .....                                                       | 37 |
| TABLE OF CONTENTS .....                                           | iv  | 4.1.2 Michigan and the United States .....                                           | 38 |
| LIST OF TABLES .....                                              | vi  | 4.2 Actions in Progress Related to Use<br>Impairments .....                          | 38 |
| LIST OF FIGURES .....                                             | vii | 4.2.1 Remediation and Prevention<br>Approaches .....                                 | 38 |
| LIST OF APPENDICES .....                                          | vii | 4.2.2 Ongoing Programs .....                                                         | 39 |
| 1.0 EXECUTIVE SUMMARY .....                                       | 1   | 4.3 Prioritization and Modelling of Sources<br>for Remediation .....                 | 46 |
| 1.1 Introduction .....                                            | 1   | 4.3.1 Sources of Fecal Coliform ( <i>E. coli</i> )<br>Bacteria for Remediation ..... | 46 |
| 1.2 Impairment of Beneficial Uses and<br>Delisting Criteria ..... | 2   | 4.3.2 Ranking of Sources for Prioritization<br>of Remediation .....                  | 46 |
| 1.3 Public Consultation Process .....                             | 2   | 4.3.3 Modelling and Use of KETOX to<br>Evaluate Remedial Options .....               | 47 |
| 1.4 Goals and Objectives .....                                    | 2   | 4.4 Actions .....                                                                    | 52 |
| 1.5 Point Source .....                                            | 4   | 5.0 NON-POINT SOURCE .....                                                           | 55 |
| 1.6 Non-Point Source .....                                        | 6   | 5.1 Regulatory Programs .....                                                        | 56 |
| 1.7 Sediment .....                                                | 6   | 5.1.1 Ontario and Canada .....                                                       | 56 |
| 1.8 Habitat .....                                                 | 7   | 5.1.2 Michigan and the United States .....                                           | 56 |
| 1.9 Public Outreach and Education .....                           | 7   | 5.2 Remedial and Prevention Measures and<br>Actions in Progress .....                | 57 |
| 1.10 Monitoring and Research .....                                | 8   | 5.2.1 Remediation and Prevention<br>Approaches .....                                 | 57 |
| 1.11 RAP Implementation .....                                     | 8   | 5.2.2 Ongoing Programs .....                                                         | 62 |
| 1.12 Actions .....                                                | 9   | 5.3 Actions .....                                                                    | 65 |
| 2.0 ENVIRONMENTAL CONDITIONS AND PROBLEM<br>DEFINITION .....      | 15  | 6.0 SEDIMENT .....                                                                   | 67 |
| 2.1 Area of Concern Characteristics .....                         | 15  | 6.1 Regulatory Programs .....                                                        | 67 |
| 2.2 Impairment of Beneficial Uses .....                           | 15  | 6.2 Remedial and Prevention Measures<br>and Actions in Progress .....                | 68 |
| 2.3 Point Sources and Related Impacts .....                       | 16  | 6.2.1 Remediation Approaches .....                                                   | 68 |
| 2.4 Non-Point Sources and Related Impacts .....                   | 22  | 6.2.2 Ongoing Programs .....                                                         | 69 |
| 2.5 Sediments .....                                               | 23  | 6.3 Ongoing RAP Activities .....                                                     | 70 |
| 2.6 Habitat .....                                                 | 24  | 6.4 Actions .....                                                                    | 73 |
| 3.0 GOALS, OBJECTIVES AND EVALUATION CRITERIA .....               | 25  | 7.0 HABITAT .....                                                                    | 75 |
| 3.1 RAP Water Use Goals and Objectives .....                      | 25  | 7.1 Habitat Protection .....                                                         | 75 |
| 3.2 Delisting Criteria .....                                      | 26  | 7.1.1 Ontario and Canada .....                                                       | 75 |
| 3.3 Yardsticks .....                                              | 28  | 7.1.2 Michigan and the United States .....                                           | 76 |
| 3.4 Development of Yardsticks .....                               | 28  | 7.2 Remedial and Prevention Measures<br>and Actions in Progress .....                | 77 |
| 3.5 Remedial Action Development .....                             | 32  | 7.2.1 Remediation Approaches .....                                                   | 77 |
| 4.0 POINT SOURCE .....                                            | 35  |                                                                                      |    |
| 4.1 Regulatory Programs .....                                     | 37  |                                                                                      |    |



|                                                                                           |    |                                                                                  |     |
|-------------------------------------------------------------------------------------------|----|----------------------------------------------------------------------------------|-----|
| 7.2.2 Habitat Restoration and Enhancement . . . . .                                       | 77 | 9.3 Research Needs for Beneficial Uses<br>Requiring Further Assessment . . . . . | 93  |
| 7.3 Actions . . . . .                                                                     | 83 | 9.3.1 Restrictions on Fish and Wildlife<br>Consumption . . . . .                 | 93  |
| 8.0 PUBLIC OUTREACH AND EDUCATION . . . . .                                               | 87 | 9.3.2 Tainting of Fish and Wildlife Flavour . . . . .                            | 94  |
| 8.1 Summary of Recent and Ongoing<br>Outreach Programs . . . . .                          | 87 | 9.3.3 Degradation of Fish and Wildlife<br>Populations. . . . .                   | 94  |
| 8.2 Actions . . . . .                                                                     | 89 | 9.3.4 Fish Tumours and Other Deformities . . . . .                               | 95  |
| 9.0 MONITORING AND RESEARCH . . . . .                                                     | 91 | 9.3.5 Degradation of Benthos . . . . .                                           | 95  |
| 9.1 Determination of Monitoring and<br>Research Needs . . . . .                           | 91 | 9.4 Point and Non-Point Source Research<br>and Monitoring Programs. . . . .      | 95  |
| 9.2 Monitoring Programs For Impairments<br>to Beneficial Use Categories . . . . .         | 91 | 9.4.1 Non-Point Sources . . . . .                                                | 95  |
| 9.2.1 Restrictions on Fish and Wildlife<br>Consumption . . . . .                          | 91 | 9.4.2 Point Sources. . . . .                                                     | 96  |
| 9.2.2 Bird or Animal Deformities or<br>Reproductive Problems . . . . .                    | 92 | 9.5 Actions . . . . .                                                            | 96  |
| 9.2.3 Degradation of Benthos . . . . .                                                    | 92 | 10.0 RAP IMPLEMENTATION . . . . .                                                | 99  |
| 9.2.4 Restrictions on Dredging Activities . . . . .                                       | 92 | 10.1 Management Structure . . . . .                                              | 99  |
| 9.2.5 Restrictions on Drinking Water Consumption<br>or Taste and Odour Problems . . . . . | 93 | 10.2 Implementation Strategies . . . . .                                         | 100 |
| 9.2.6 Beach Closings . . . . .                                                            | 93 | 10.3 Tracking and Evaluation Mechanisms . . . . .                                | 101 |
| 9.2.7 Degradation of Aesthetics. . . . .                                                  | 93 | 10.4 Public Role and Responsibilities . . . . .                                  | 107 |
| 9.2.8 Added Cost to Agriculture or Industry . . . . .                                     | 93 | 10.5 Actions . . . . .                                                           | 107 |
| 9.2.9 Loss of Fish and Wildlife Habitat. . . . .                                          | 93 | 11.0 BIBLIOGRAPHY. . . . .                                                       | 109 |
|                                                                                           |    | 12.0 GLOSSARY AND ACRONYMS . . . . .                                             | 111 |

|           |                                                                                                                            |   |
|-----------|----------------------------------------------------------------------------------------------------------------------------|---|
| TABLE 1.1 | St. Clair River AOC Delisting Criteria For Each Impaired Beneficial Use and Relationship to RAP Goals and Objectives. .... | 3 |
|-----------|----------------------------------------------------------------------------------------------------------------------------|---|

|           |                                                                                                               |    |
|-----------|---------------------------------------------------------------------------------------------------------------|----|
| TABLE 1.2 | Summary of actions and responsible agencies or facilities for implementation of the St. Clair River RAP. .... | 10 |
|-----------|---------------------------------------------------------------------------------------------------------------|----|



|           |                                                                                                                   |    |
|-----------|-------------------------------------------------------------------------------------------------------------------|----|
| TABLE 2.1 | Summary of impairments to Great Lakes Water Quality Agreement beneficial uses within the St. Clair River AOC..... | 19 |
|-----------|-------------------------------------------------------------------------------------------------------------------|----|

|           |                                                                                                                                       |    |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------|----|
| TABLE 2.2 | Use Impairments and Contaminants Associated with Sources in the St. Clair River watershed (modified from Beak 1993, Table 3.7.1)..... | 21 |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------|----|

|           |                                                                                                                 |    |
|-----------|-----------------------------------------------------------------------------------------------------------------|----|
| TABLE 3.1 | St. Clair River AOC Delisting Criteria For Each Impaired Use and Relationship to RAP Goals and Objectives. .... | 27 |
|-----------|-----------------------------------------------------------------------------------------------------------------|----|

|           |                                                                            |    |
|-----------|----------------------------------------------------------------------------|----|
| TABLE 3.2 | Environmental water quality "yardsticks" for the St. Clair River RAP ..... | 29 |
|-----------|----------------------------------------------------------------------------|----|

|           |                                                                                 |    |
|-----------|---------------------------------------------------------------------------------|----|
| TABLE 3.3 | Environmental sediment and biota "yardsticks" for the St. Clair River RAP ..... | 30 |
|-----------|---------------------------------------------------------------------------------|----|

|           |                                                                                                                                                                   |    |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| TABLE 3.4 | Parameters for which desirable "Yardstick" levels are below (shaded) documented lower Lake Huron levels or standard analytical Method Detection Limit (MDL). .... | 31 |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|

|           |                                                                                              |    |
|-----------|----------------------------------------------------------------------------------------------|----|
| TABLE 4.1 | Point source priorities for St. Clair River Remedial Action Plan based on net loadings ..... | 48 |
|-----------|----------------------------------------------------------------------------------------------|----|

|           |                                                                                                    |    |
|-----------|----------------------------------------------------------------------------------------------------|----|
| TABLE 4.2 | Estimated Peak Concentrations in Water and Sediment From Each Model Scenario (all values ppb)..... | 50 |
|-----------|----------------------------------------------------------------------------------------------------|----|

|           |                                                                                                                                                        |    |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| TABLE 4.3 | Source Loadings Contribution to Exceedences (+) of Yardstick Values for Each of Three Model Scenarios (based on data provided by Nettleton 1994). .... | 51 |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------|----|

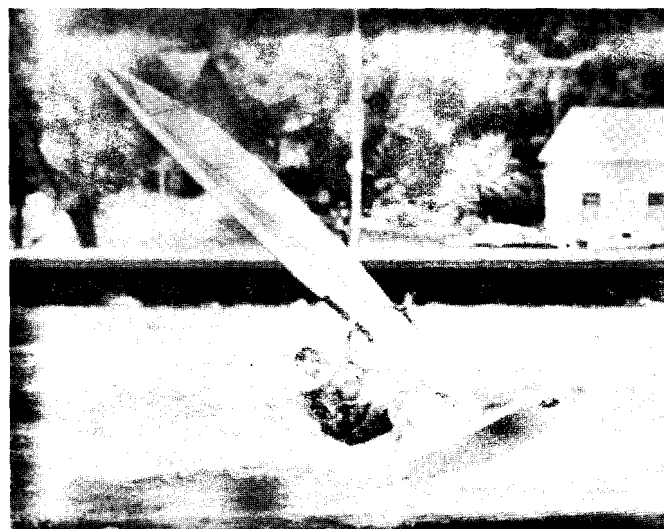
|           |                                                                             |    |
|-----------|-----------------------------------------------------------------------------|----|
| TABLE 5.1 | Status of Ontario waste disposal sites, landfills and injection wells. .... | 59 |
|-----------|-----------------------------------------------------------------------------|----|

|           |                                                                                                                                                                                            |    |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| TABLE 5.2 | Identified Michigan Act 307 and leaking underground storage tank (LUST) sites in St. Clair County for which no clean-up or assessment Action has been initiated (as of January 1994). .... | 60 |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|

|            |                                                                                                                                                       |     |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| TABLE 10.1 | Summary of significant actions, responsible agencies or facilities, and completion date (by task) for implementation of the St. Clair River RAP. .... | 102 |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-----|

|            |                                                                                                                 |     |
|------------|-----------------------------------------------------------------------------------------------------------------|-----|
| TABLE 10.2 | Approximation of costs required on behalf of public agencies to implement selected actions from Table 10.1..... | 106 |
|------------|-----------------------------------------------------------------------------------------------------------------|-----|

|            |                                                                                                                                                        |    |     |                                                                  |  |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|----|-----|------------------------------------------------------------------|--|
| Figure 2.1 | Location of St. Clair River RAP Study Area and Major Land Uses. ....                                                                                   | 17 | 3.1 | Yardstick Background Document                                    |  |
| Figure 2.2 | Extent of Existing and Historical Wetlands within the St. Clair River Watershed. ....                                                                  | 18 | 3.2 | Task Team Work Plans                                             |  |
| Figure 3.1 | Process for Assessment and Evaluation of Remedial Options for Point Source, Non-Point Source, Habitat and Sediment, and Common Issues Task Teams. .... | 33 | 4.1 | Regulations                                                      |  |
| Figure 4.1 | Location of Major Point Source Dischargers to the St. Clair River ...                                                                                  | 36 | 4.2 | Loadings Values Utilized for KETOX Model Scenarios               |  |
| Figure 4.2 | KETOX Model Output Results for Benzene in Water. ....                                                                                                  | 49 | 4.3 | Ontario Remedial Technology and Costs (BEAK 1993 Report)         |  |
| Figure 5.1 | Location of waste disposal sites, landfills and leaking underground storage tanks without leachate or runoff collection systems. ....                  | 58 | 4.4 | GIS Output Maps for Each KETOX Water and Sediment Scenario       |  |
| Figure 5.2 | Location of waste disposal wells in the St. Clair River Area of Concern. ....                                                                          | 61 | 5.1 | Non-point Source Priorities                                      |  |
| Figure 6.1 | Sediment Remediation Decision Tree. ....                                                                                                               | 71 | 5.2 | Sewell Commission Recommendations (Sewage Treatment and Septics) |  |
| Figure 6.2 | Location of impact zones as defined by the RAP Sediment Task Team. ....                                                                                | 72 | 6.1 | Sediment Characterization Project Descriptions                   |  |
| Figure 7.1 | Candidate sites within the St. Clair River AOC for potential habitat rehabilitation/enhancement (OMNR 1994). ....                                      | 80 | 7.1 | Technical and Public Comment Response Documents                  |  |
|            |                                                                                                                                                        |    | 8.1 | St. Clair River Remedial Action Plan Addendum                    |  |



## ■ 1.1 Introduction

**T**he St. Clair River Stage 1 Remedial Action Plan (RAP), defining environmental problems ("impairments to beneficial uses") affecting the St. Clair River was released in 1991. The Stage 1 RAP identified current environmental conditions including trends through time. Impairments were identified, however, one of the more significant findings was the substantial improvements in environmental quality which had occurred over the last decade. These improvements have largely been the result of regulatory or voluntary initiatives on the part of local industries and municipalities in Ontario and Michigan and, in particular, petrochemical facilities located in the Sarnia/Lambton area. Since release of the Stage 1 report, RAP efforts have been focused on finding solutions to the remaining problems and prioritizing actions in order to restore beneficial uses. This document, which represents the findings from the Stage 2 RAP, presents the framework for restoring the environmental integrity of the St. Clair River and recommended remedial and preventive actions to reach these goals. In some cases, the remedial and preventative actions are not fully developed in this document. In those instances, the next steps that will be taken to develop the preferred remedial actions are outlined in the report.

Where conclusive information is lacking, actions listed in this document will be further evaluated for their linkages with identified impairments and prioritized in light of competing environmental initiatives and expected benefits to the St. Clair River and surrounding environment.

The next step in the RAP process will focus on:

- prioritizing actions that will clearly lead to removal of impairments;

- obtaining commitments (including funding) from those responsible and proceed with carrying out the priority actions listed in this document; and
- further refining plans for those areas where the remedial actions have not yet been fully developed.

RAP participants have attempted to prescribe actions for delisting of the St. Clair River as an Area of Concern. Some actions may yield greater environmental benefits and would receive a higher priority in committing limited resources. The RAP is principally concerned with restoring impairments to beneficial uses and, as such, will prioritize these actions while promoting other actions which will further improve environmental conditions in the area.

To more comprehensively address the environmental problems defined in the Stage 1 RAP, the scope of the RAP has been broadened to encompass the immediate drainage basin of the St. Clair River (Chapter 2). The eastern watershed draining from Ontario consists of several small tributaries encompassing an area of about 20,976 ha (51,832 acres). The Michigan watershed, encompassing the Black, Belle and Pine Rivers, is significantly larger at 315,900 ha (780,589 acres). Consideration of the entire watershed is essential for the RAP as activities anywhere within the drainage basin can lead to downstream impacts.

The watershed defined does not incorporate upstream sources contributing to the head of the St. Clair River from Lake Huron. As Lake Huron contributes by far the greatest amount of water to the river, pollutant contributions from the lake can not be ignored. In particular, loadings of pesticides, mercury, total PCBs, phosphorus, chloride, hexachlorobenzene and suspended solids from Lake Huron are known to be significant. This RAP cannot directly address minimization or elimination of these



sources, but does commit to continued monitoring of these and other inputs to the St. Clair River. It is also recommended that reductions of contaminants of concern within the St. Clair River Area of Concern (AOC) be a priority for the proposed Lake Huron Lakewide Management Plan (LaMP).

Atmospheric inputs may also be contributing to contamination of the St. Clair River via direct deposition, its tributaries and Lake Huron; however, insufficient data exist for a full evaluation of the presence and distribution of atmospherically derived contaminants. This RAP strongly supports further investigations to ascertain the extent of the problem.

The Stage 2 RAP Recommended Plan summarizes the results of the Stage 1 report and addendum report which outline the nature and extent of environmental problems in the St. Clair River AOC (Chapter 2). Chapter 3 outlines the process undertaken to complete Stage 2, goals and objectives of the RAP and appropriate delisting criteria for those beneficial uses assessed as impaired. The remainder of the report provides specific recommended actions for implementation (Stage 3) relating to point sources (Chapter 4), non-point sources (Chapter 5), sediments (Chapter 6), habitat (Chapter 7), public outreach and education (Chapter 8), required monitoring leading to delisting and research needs to fully evaluate the status of certain other beneficial uses (Chapter 9), and the strategy for RAP Implementation (Chapter 10). The actions identified and time frame for their implementation are summarized at the end of this executive summary (Section 1.11).



## ● 1.2 Impairment of Beneficial Uses and Delisting Criteria

Table 1.1 lists the impairments of beneficial uses (9 of 14 impairments of beneficial uses as defined by the IJC) determined in the Stage 1 report,

Addendum Report and subsequently. The delisting criteria, as defined by the RAP Team and Binational Public Advisory Council (BPAC), for each impairment is also indicated.

## ● 1.3 Public Consultation Process

This Stage 2 document has been created as the result of extensive public consultation and input to derive a community-based consensus report. As such, it attempts to accurately portray the collective interests and will of the local community. This document has been reviewed on several occasions by task team members through facilitated workshops, meetings and individual review. It is the product of a joint effort involving local interested citizens within and outside of BPAC as well as Agency representatives. The implementation of recommended actions thus is supported by all stakeholders; this will certainly enhance the success of the remediation and cleanup of the St. Clair River AOC.

The Stage 2 process involved a series of facilitated workshops and the creation of four task teams. Point sources and non-point sources of contamination were evaluated and assessed by the Point Source and Non-Point Source task teams, respectively. A Sediment and Habitat Task Team addressed issues relating to contaminated sediments and the loss of wildlife habitat. A Common Issues Task Team was struck to fill any gaps among the other task teams and address cross-cutting concerns; their primary focus dealt with public awareness and education.

## ● 1.4 Goals and Objectives

One of the first tasks of the Stage 2 process was the development of specific water use goals and objectives to direct the work of the task teams and, eventually, result in delisting of the impairments of beneficial uses (Table 1.1). The goals and objectives were developed jointly by the RAP Team and BPAC.

# St. Clair River AOC Delisting Criteria For Each Impaired Beneficial Use and Relationship to RAP Goals and Objectives.

## Impairment of Beneficial Use (\*)

## Delisting Guideline

Restrictions on fish and wildlife consumption

When contaminant levels in fish and wildlife populations do not exceed current standards, objectives or guidelines and no public health advisories are in effect for human consumption of fish and wildlife.

Bird or animal deformities or reproductive problems

When chironomid mouthpart anomalies occur at rates similar to incidences in "control" populations.

Degradation of benthos

When invertebrate community structure can be documented as unimpaired or intermediate as defined by recent OMOEE benthic investigations.

Restrictions on dredging activities

No limitations on disposal of dredging spoils.

Restrictions on drinking water consumption or taste and odour problems

No treatment plant shutdowns due to exceedences of drinking water guidelines over a two year period.

Beach Closings

Zero beach closings based on fecal coliform standards regulating beach closings over a two year period.

Degradation of aesthetics

When over a two year period there is/are no, objectionable deposits, unnatural colour or turbidity, unnatural odour or unnatural scum/floating materials.

Added costs to agriculture or industry

No plant shutdowns attributable to water quality over a two year period.  
No added costs for the disposal of contaminated sediments.

Loss of fish and wildlife habitat.

### Protection:

1. Regulations - Ensure that sufficient enforceable mechanisms are in place to protect existing aquatic and wetland habitat from cultural destruction or degradation, including filling, dredging, adversely affecting the hydrology, cutting or removing vegetation required for habitat, and allowing pollutants such as sediment, excess nutrients or toxic substances to enter aquatic or wetland habitat.
2. Acquisition - Acquire into public ownership an additional 800 acres (324 ha) of wetland habitat in Michigan by the year 2000.
3. Protect existing habitat in Ontario.

### Restoration and Enhancement:

1. Of the 5200 ha (12,844 acres) identified as "Candidate Sites" in Ontario, complete the following habitat rehabilitation projects by the year 2000:
  - Chenal Ecarté Wetland Creation (155 ha) (384 acres)
  - Stag Island (80 ha) (198 acres)
  - Darcy McKeough Floodway (445 ha) (1100 acres)
2. Reclaim and restore 200 acres (81 ha) of Michigan state-owned public bottomlands currently in private use by the year 2000.
3. Restore an additional 150 acres (61 ha) of wet prairie/meadow habitat in Michigan by the year 2000.
4. Enhance 2000 acres (809 ha) of wildlife habitat in Michigan by the year 2000.
5. A long term habitat management plan for both Michigan and Ontario, including an assessment of needs (GAP Analysis) relating to wildlife diversity and integrity, will be completed to ensure continued habitat restoration and protection beyond RAP delisting.

(\*) Subset of IJC list of 14 "Impairments of Beneficial Uses"

A series of six qualitative goals were defined as follows:

### **Aesthetics**

Achieve and maintain an aesthetically pleasing clean "blue water" and an appropriate balance of natural shoreline and human uses. There should be sufficient public access to the river for recreation, enjoyment and cultural activities;

### **Consumption of Fish and Wildlife:**

Eliminate the need for restrictions on human consumption of fish and wildlife for reasons of health;

### **Ecosystem Health:**

Attain and maintain healthy, diverse and self-sustaining biological communities and habitats. Ensure that there are no negative impacts on the health of local populations due to water quality. Ensure no net loss of fish and wildlife habitat and reclaim, rehabilitate and enhance habitat where possible;

### **Recreation and Shipping:**

Ensure that the water quality is safe for body contact at all times. Eliminate adverse effects caused by recreational and shipping activities;

### **Sources of Contamination:**

Ensure that no source (point or non-point) impairs water quality. Eliminate spills; and

### **Water Supply:**

Ensure that an adequate and affordable water supply, in quality and quantity, is available from the St. Clair River for users at all times.

Specific objectives for each goal have also been defined, all of which have a target for achievement by the year 2000. Because use impairments reflect many decades of ecosystem abuse, it may take many years to totally restore environmental integrity, however, the delisting criteria reflect goals for substantial improvement within a reasonable short time frame.

In addition to the goals and objectives and delisting criteria, the RAP Team and BPAC also developed an

AOC-specific set of water, sediment and biota quality guidelines referred to as "yardsticks". These yardsticks are presented in Chapter 3. They were derived from several jurisdictions and represent the most stringent criteria available for each contaminant. These yardsticks are proposed as the values required to be achieved as a result of RAP implementation.

The St. Clair River RAP is aware of the connections between human health and the environment. Many of the remedial activities underway or proposed will make the AOC a healthier place to live by reducing levels of contaminants in the water, sediment, food and air.

## **▲ 1.5 Point Source**

A point source was defined as "Any discrete, quantifiable discharge (air and/or water), e.g., outfall, pipe, conduit, lined ditch/channel, tunnel, which discharges directly to the St. Clair River or its tributaries from sources including industrial/municipal discharges". These discharges include: storm water runoff from developed areas of industrial sites/activities; urban storm runoff; spills; CSOs; residential discharges; and landfill leachate systems.

Early in the Stage 2 process, the RAP Team commissioned a study to evaluate technical options for remediation of use impairments. This report (Beak 1993) outlined detailed, site-specific technical options and approximate costs for addressing source controls as well as sediment and habitat remediation. The Beak (1993) report has been included in its entirety as Appendix 4.3 to this Stage 2 document. Following extensive discussions with BPAC and RAP Team members, it was agreed that with respect to point sources, a more effective approach would be to identify performance expectations or a "yardstick" necessary to achieve RAP goals and objectives and to rely on individual sources to comply. This was felt to be the approach most likely to succeed given the complex technical, economic and social issues at hand for each facility. The RAP will pursue the



achievement of these "yardsticks" through ongoing monitoring and iterative discussions with both municipal and industrial dischargers.

The Point Source Task Team developed an evaluation and ranking system for contaminants and sources based on scoring the impact to each media (based on yardstick values) from individual parameters. The formula for determining individual media scores is as follows:

$$\text{Parameter Impact Score} = \text{No. Uses Impaired} \times (100 / (\text{parameter yardstick} / \text{mercury yardstick}) \times \text{total loading})$$

The highest priority sources (sum of media impact scores greater than or equal to 1.9), based on this ranking process were determined to be:

|                               |                                                                                                                                                                       |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cole Drain                    | Hexachlorobenzene;<br>Hexachlorobutadiene;<br>Pentachlorobenzene;<br>Octachlorostyrene;<br>Nickel                                                                     |
| Dow Chemical                  | Copper; Zinc;<br>Hexachlorobenzene                                                                                                                                    |
| Imperial Oil Ltd.<br>Refinery | Arsenic; Phosphorus                                                                                                                                                   |
| Ethyl                         | Lead; Mercury; 1,2-Dichloroethane;<br>1,1-Dichloroethane; Carbon<br>Tetrachloride; 1,1,2-Trichloroethane;<br>Tetrachloroethylene;<br>Trichloroethylene; PAHs; Toluene |
| Marysville WWTP               | Phosphorus                                                                                                                                                            |
| Novacor (Corunna)             | Arsenic                                                                                                                                                               |
| Polysar                       | Benzene; Oil & Grease; Phosphorus                                                                                                                                     |
| Port Huron WWTP               | Cadmium; Phosphorus                                                                                                                                                   |
| Sarnia WPCP                   | Zinc; Cadmium; Iron; Phosphorus;<br>Copper; Nickel; Lead; Mercury                                                                                                     |
| St. Clair WWTP                | Mercury                                                                                                                                                               |
| Suncor                        | Arsenic                                                                                                                                                               |



In addition, selected contaminants were modelled using the KETOX fate and effects model for sediment and water. Four different loading scenarios were employed to determine the contributions of individual sources to contaminant levels in the water and river sediment. Where contaminant concentrations exceeded yardstick values the water or sediment was considered impaired. Modelling scenarios include:

1. Contaminant levels in water from the Stage 1 RAP (1991);
2. Contaminant levels in water and sediment from the Stage 1 RAP Addendum (1993);
3. Contaminant levels in water and sediment from current information (industrial discharges 1994); and
4. Projected contaminant levels in water and sediment.

Parameters modelled include: hexachlorobenzene; lead; mercury; tetrachloroethylene; benzene; carbon tetrachloride; cadmium; and zinc. The selection of these parameters was not based on the final ranking but on the availability of complete data. As a result of the modelling, those sources which were

found to contribute to exceedences of yardstick values, based on the Stage 1 Update loading scenario, are:

|                |                                  |
|----------------|----------------------------------|
| Cole Drain     | Hexachlorobenzene                |
| Dow            | Zinc, Mercury, Hexachlorobenzene |
| Polysar        | Benzene                          |
| St. Clair WWTP | Mercury                          |

The City of Sarnia has submitted Pollution Control plans in order to abate their sewage treatment, CSO (combined sewer overflow) and stormwater problems. The cities of Port Huron and Marysville are planning and/or implementing CSO control plans. The cities of Yale, St. Clair, Capac and Marine City completed sewer separation in 1994.

## ● 1.6 Non-Point Source

The general nature of this topic, non-point sources, has resulted in Chapter 5 being less complete than other chapters hence, non-point source generalizations make it difficult to be specific about recommendations and responsibilities.

Available data indicates that non-point sources and Lake Huron contribute at least ten percent of the total loadings to the St. Clair River for the following parameters: copper, iron, lead, mercury, nickel, cadmium, cobalt, PAHs and PCBs. For substances such as mercury and PCBs, the majority enters from Lake Huron resulting from airborne deposition to the lake. In addition, non-point phosphorus and zinc contributions are close to ten percent of the total loadings.

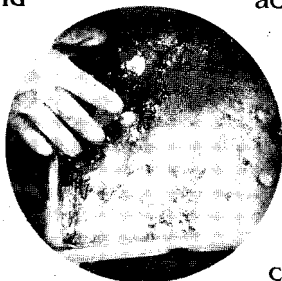
The Non-Point Source Task Team identified and focused on six non-point sources of contaminants in the St. Clair River watershed, exclusive of Lake Huron. These sources include:

- (1) urban storm runoff (excluding storm runoff from industrial sites and CSOs);
- (2) rural storm runoff;
- (3) waste sites without leachate and runoff collection;
- (4) malfunctioning septic systems;
- (5) all domestic sources not connected to municipal treatment facilities; and
- (6) generation of household hazardous waste (HHW).

Evaluation of Ontario landfill and waste disposal sites identified two potential problem sites, the Ladney Waste Disposal Site and the Canatara Landfill (Chapter 5). In addition, it was revealed that there is not enough information available to make an assessment for the Dow LaSalle Road, Dupont, and Shell Canada waste disposal sites and the Walpole Island, Moore Township, and Sombra Township landfills.

In St. Clair County, Michigan, nine 307 sites (contaminated sites identified for remediation under the *Michigan Environmental Response Act* and the *Comprehensive Environmental Response, Compensation and Liability Act*) and 4 known leaking underground storage tanks have not been remediated. However, none of the sites are on the list 307 Highest Ranking Sites requiring immediate clean-up. There are no documented effects to the St. Clair River or its tributaries from these sites.

A number of ongoing programs focusing on the reduction and eventual elimination of contaminants to the St. Clair River through agricultural practices are identified in Chapter 5. Several sewer construction projects are also described in Chapter 5. Local non-point source control activities (e.g. CURB Program) and the importance of watershed assessment have accelerated as a result of the RAP.



## ● 1.7 Sediment

Parameters of concern in St. Clair River sediment include: total Kjeldahl nitrogen, total phosphorus, arsenic, mercury, cadmium, copper, chromium, iron, lead, nickel, zinc, manganese, oil and grease, PCBs, hexachlorobenzene and total PAHs.

The Sediment and Habitat Task Team developed a "Sediment Remediation Decision Tree" to determine the most suitable option for contaminated sediment remediation in the St. Clair River.

Results from the OMOEE 1990 sediment study were used to characterize and prioritize sediment impact zones. Prioritization was based on the following criteria:

Priority 1 zones are characterized by Severe Effect Level (SEL) exceedences, degraded benthos and sediment toxicity.

Priority 2 zones are less impacted with SEL exceedences, and impaired benthos.

Priority 3 zones are identified with SEL exceedences.

As a result of this process three Priority 1, four Priority 2, and four Priority 3 sediment impact zones were identified. All impact zones are located in the upper St. Clair River along the Chemical Valley with Priority 1 zones located at and immediately downstream of Polysar Rubber Corp., Novacor Chemicals (Sarnia) and Dow Chemical; Suncor Inc.; and Ethyl Canada Inc., DuPont Canada and Novacor Chemicals (Corunna).

Sediment characterization studies are outlined in Chapter 6 and will be conducted on the Priority 1 zones. Results from these studies will be used to develop remedial measures for these areas.

## ▲ 1.8 Habitat

Loss of habitat has been identified as an impaired beneficial use in the St. Clair River AOC Stage 1 RAP. The protection of wildlife habitat involves the application of legislation and regulatory programs. Federal, Provincial and State legislation are reviewed and procedures for habitat protection discussed.

The Sediment and Habitat Task Team has defined a set of principles that are to be adhered to in all existing and planned actions for habitat protection, restoration and enhancement in the St. Clair River watershed. These principles are as follows:

- (1) no further losses of current wildlife habitat;
- (2) gain in wetland and aquatic habitat wherever and whenever possible;
- (3) focus on areas of contiguous habitat, with a minimization of habitat fragmentation;
- (4) make provisions for diverse habitats and communities (*i.e.* an ecological approach); and

- (5) set a high priority for endemic species, communities and habitats.

Numerous habitat restoration and enhancement programs are ongoing in both Ontario and Michigan and are outlined in Chapter 7. The majority of these projects are focused in the St. Clair River delta region. Thirty-five candidate sites, located along the entire length of the St. Clair River and its delta, have been identified by OMNR and MDNR for potential habitat rehabilitation and/or enhancement. Both organizations are currently exploring funding mechanisms for habitat restoration and enhancement.

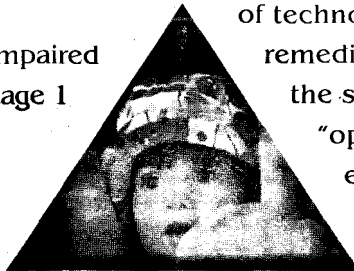
The OMNR (1994) candidate site report evaluates and prioritizes areas based on a complex scheme involving cost/benefits; design; partnerships and sustainability as well as a number of other critical factors. It also provides a comprehensive evaluation of technologies and feasibility for specific remedial actions at Candidate Sites. Perhaps the single most important factor lies in "opportunities" that present themselves either through concerted efforts to gain interest from land owners and potential partners or unsolicited interest. As a consequence, priorities may be altered to reflect "opportunities" which offer a more streamlined means to move towards RAP goals and objectives.

Ongoing actions pertaining to habitat protection, restoration and enhancement were itemized into three categories: protection; rehabilitation and enhancement; and education and communication. Actions relating to exotic species are also outlined.

## ▲ 1.9 Public Outreach and Education

The primary goals of the public outreach and education activities undertaken by the RAP Team and BPAC are:

- develop and implement an environmental education program for local schools;



- increase public awareness of the RAP, its Goals and Objectives;
- develop and implement educational programs for the general public; and
- encourage and enhance public involvement in all phases of RAP implementation.

Thirteen educational and public outreach programs undertaken within the St. Clair River AOC are described and recommendations for continued/additional programs are outlined.

## 1.10 Monitoring and Research

The Stage 2 RAP identifies monitoring programs required to determine progress toward meeting the RAP goals and objectives. Additional research to further evaluate those use impairments which have not been adequately assessed is also identified. Monitoring requirements are noted for each of the nine impaired uses. Many on-going agency and industry monitoring programs will be sufficient to meet the requirements of the RAP. However, some programs require adjustments to sampling locations, frequency of sampling, and parameters to be measured/estimated.



Twelve proposed or on-going non-point source monitoring programs are described. These programs include air monitoring programs, tributary monitoring (Sydenham and Black Rivers), CSO and urban runoff monitoring, nearshore bacteriological surveys and detailed watershed surveys in both Michigan and Ontario. Investigations are currently under way to determine the cost, timing and feasibility for mass balance and/or St. Clair River head and mouth surveys.

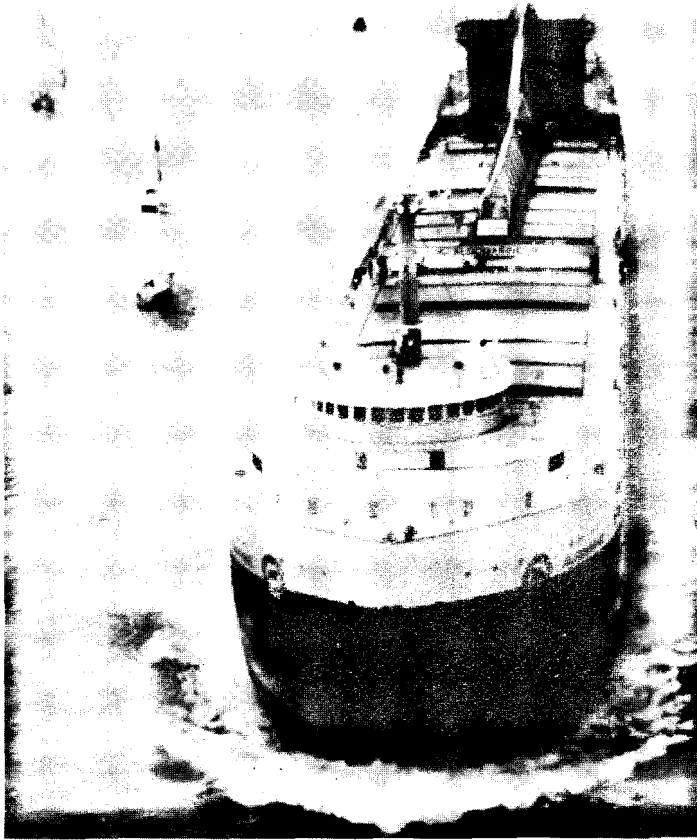
Current point source monitoring includes industry self-monitoring requirements in Ontario and Michigan. In addition, new monitoring requirements will be specified in the MISA effluent regulations once they are promulgated. Additional monitoring may be required at certain facilities to ensure priority contaminant loadings reflect actions identified by the Point Source Task Team.

## 1.11 RAP Implementation

Implementation of the RAP involves the commitments on behalf of responsible parties; a management and co-ordination structure; tools and procedures to track implementation; evaluation of the success of remedial activities; appropriate funding to undertake actions; and the identification of additional actions, as needed.

A formal implementation structure is proposed which consists of a RAP Implementation Committee and a RAP Accountability Committee which will evolve from the RAP team and BPAC respectively. The first consists of representatives of those agencies responsible to ensure implementation. Its responsibilities relate to overall co-ordination of RAP implementation activities, including tracking and evaluation of recommended actions, tracking and assessment of monitoring activities and the assessment of impaired use status. This committee will be responsible for developing detailed workplans relating to the implementation of recommended actions and to monitoring and





Targets for restoration of degraded areas and the conservation and protection of human and ecosystem health have been established under the Canada-Ontario Agreement (COA). The remedial actions outlined in this document are largely consistent with these targets and indeed some (those under the jurisdiction of Canada/Ontario) may benefit from priorities established as part of the Agreement.

In addition to the expertise and resources available through government and private sector activities, the RAP will where possible utilize the resources and expertise available locally (e.g. Community Colleges). Of particular benefit to the RAP will be those programs responsible for training students in the fields of resource management, environmental technology and engineering.

research activities. The Accountability Committee is an arms-length committee with representation from each of the stakeholders groups. It will serve an auditing, review and reporting function which will maintain regular contact with the public.

The strategy for implementation is based on assigning responsibility for recommended actions and ensuring that the funding is in place. Written commitments regarding loading reductions have already been obtained and these are outlined in the report. To date commitments have been obtained from Dow Chemical Canada, DuPont Canada, Imperial Oil Ltd. Chemicals Division, Imperial Oil Ltd. Refinery Division, Novacor Chemicals (Mooretown), Polysar Rubber, and St. Clair Wastewater Treatment Plant (WWTP). Each facility and agency will be responsible for implementing assigned actions through consensus but when necessary employing appropriate regulations. Several of the actions, particularly those relating to public and business community education are to be undertaken by the RAP Implementation Committee.



## ● 1.12 Actions

The following table summarizes the main recommended actions according to the agencies with primary responsibility for implementation.



# Summary of Actions and Responsible Agencies or Facilities for Implementation of the St. Clair River RAP

*Agencies/facilities noted are those with primary responsibility and are not meant to be all inclusive with regard to funding sources*

## Agency and or Facility

## Action

### Industry

Cole Drain  
Dow  
Ethyl  
Imperial Oil Ltd. Refinery  
Novacor (Corunna)  
Polysar  
Shell Canada  
Suncor

### POINT SOURCE

- Determine whether yardstick is met or exceeded at end of pipe for persistent and bioaccumulative substances and persistent, potentially bioaccumulative substances.
- Meet yardstick at end of pipe for persistent and bioaccumulative substances and persistent, potentially bioaccumulative substances.
- Meet yardstick at edge of mixing zone for persistent (non-bioaccumulative) and non-persistent, non-bioaccumulative substances.
- Virtually eliminate all persistent and bioaccumulative contaminants from discharge.

### Municipal

Corunna WPCP  
Marysville WWTP  
Port Huron WWTP  
Sarnia WPCP  
St. Clair WWTP

- Determine whether yardstick is met or exceeded at end of pipe for persistent and bioaccumulative substances and persistent, potentially bioaccumulative substances.
- Meet yardstick at end of pipe for persistent and bioaccumulative substances and persistent, potentially bioaccumulative substances.
- Meet yardstick at edge of mixing zone for persistent (non-bioaccumulative) and non-persistent, non-bioaccumulative substances.
- Virtually eliminate all persistent and bioaccumulative contaminants from discharge.

### Municipalities with Storm Sewers and CSOs – Sarnia, Port Huron, Marysville

- All effluents will be disinfected or otherwise treated in order to achieve coliform bacteria yardstick.

### All Point Sources, Industrial and Municipal

- Eliminate spills
- Inventory atmospheric discharges for all yardstick substances.
- All point sources not meeting yardsticks will develop a pollution prevention/toxics release plan.
- Strive to attain zero discharge of contaminants.
- Relevant point sources will eliminate all contaminated discharges/leachate to the Cole Drain (once-through cooling water excepted).
- Assess storm water impacts.

### OMOEE and MDNR

- Adjust existing yardsticks as required and set new yardsticks.
- Develop discharge permits on the basis of discharges already approved or under application and assess total mass loadings to the river.
- Develop a "whole plant" permitting system.
- Conduct toxic reduction education for small business.

### MDNR

- Assess storm water impacts.

### EPA

- Develop a means to define the impacts of point source discharges to the atmosphere.
- Assess storm water impacts.

### Environment Canada

- Conduct toxic reduction education for small business.

### RAP Implementation Committee

- Develop a means to define the impacts of point source discharges to the atmosphere.

cont'd

## Agency and/or Facility

## Action

### OMOEE, Conservation Authorities & MDNR

#### NON-POINT SOURCE

- Develop watershed/subwatershed management plans.
- Reduce the use of road salt and seek alternatives.
- Protect existing natural areas and undertake remedial measures (*i.e.* CURB program).
- Improve waste site planning and management by: developing incentives; implementing pollution prevention measures; ensuring proper disposal; ensure proper closing and capping of bore holes, wells, waste disposal sites and landfills; use BAT for new waste sites; improve accountability; monitor and remediate contaminated groundwater.
- Correct direct discharges of untreated greywater.

### Conservation Authorities

- Develop watershed/subwatershed management plans.
- Protect existing natural areas and undertake remedial measures (*i.e.* CURB program).

### Municipalities and/or Local Governments

- Develop watershed/subwatershed management plans.
- Enforce urban runoff pollution control bylaws at existing developments.
- Maintain pre-development hydrography for new developments and maintain natural areas.
- Construct on-site pollution controls for urban runoff in existing areas.
- Link urban/rural stormwater control through subwatershed plans.
- Reduce the use of lawn fertilizers and pesticides.
- Improve waste site planning and management by: developing incentives; implementing pollution prevention measures; ensuring proper disposal; ensure proper closing and capping of bore holes, wells, waste disposal sites and landfills; use BAT for new waste sites; improve accountability; monitor and remediate contaminated groundwater.
- Identify problems relating to domestic sanitary sources and ensure proper maintenance/repair.
- Correct direct discharges of untreated greywater.
- Ensure proper use and disposal of household hazardous wastes and product substitution through programs and education.
- Reduce use of road salt and/or seek alternatives.

### Developers

- Ensure proper urban runoff pollution control measures are operating according to bylaws at existing developments.
- Maintain pre-development hydrography for new developments and maintain natural areas.
- Construct on-site pollution controls for urban runoff in existing areas.

### Conservation Authorities

- Link urban/rural stormwater control through subwatershed plans.

### Transport Agencies

- Reduce the use of road salt and seek alternatives.

### USDA/NRCS

- Develop watershed/subwatershed management plans.
- Promote agricultural programs and technology to reduce contamination of rural runoff.

### MDNR, OMAF, Agriculture Canada & MDA

- Promote agricultural programs and technology to reduce contamination of rural runoff.

### EPA and Environment Canada

- Assist in development of watershed/subwatershed management plans.

### Residents

- Reduce the use of lawn fertilizers and pesticides.
- Identify problems relating to domestic sanitary sources and ensure proper maintenance/repair.
- Ensure proper use and disposal of household hazardous wastes and product substitution through programs and education.

cont'd

## Agency and or Facility

## Action

### Public Health Authorities

### NON-POINT SOURCE

- Identify problems relating to domestic sanitary sources and ensure proper maintenance/repair.

### U.S. & Canadian Coast Guards

- Correct direct discharges of untreated greywater.

### RAP Implementation Committee

- Develop a means to define the impacts of non-point source discharges to the atmosphere.

### OMOEE

### SEDIMENT

- Complete sediment characterization study and Priority 1 Zone characterization.
- Review a study on sediment transport mechanisms for sediment characterization.
- Undertake in-situ pilot scale remediation studies.
- Develop final remediation strategy.

### LIS

- Complete sediment characterization study.

### OMNR and MDNR

### HABITAT

- Ensure protection of shorelines from erosion and protect/enhance/restore other natural habitats in the watershed.
- Control/eradicate exotic species.
- Undertake identified habitat restoration and enhancement projects; expand candidate sites; maximize fish use of delta habitats; encourage maintenance/enhancement of riparian vegetation; improve co-ordination amongst conservation/protection agencies; expand list of special status species.
- Develop a long-term habitat management plan.
- Assess the requirements needed to maintain wildlife diversity and integrity (GAP analysis).

### Ontario and Michigan Legislatures

- Strengthen wetland protection measures.

### MDNR, U.S. & Canadian Coast Guards,

### USACOE, USFWS

- Reduce ship wakes and surges and minimize impacts from winter shipping.

### Conservation Agencies

- Ensure protection of shorelines from erosion and protect/enhance/restore other natural habitats in the watershed.
- Undertake identified habitat restoration and enhancement projects; expand candidate sites; maximize fish use of delta habitats; encourage maintenance/enhancement of riparian vegetation; improve co-ordination amongst conservation/protection agencies; expand list of special status species.
- Develop a long-term habitat management plan.
- Assess the requirements needed to maintain wildlife diversity and integrity (GAP analysis).

### Environment Canada

- Strengthen wetland protection measures.
- Undertake identified habitat restoration and enhancement projects; expand candidate sites; maximize fish use of delta habitats; encourage maintenance/enhancement of riparian vegetation; improve co-ordination amongst conservation/protection agencies; expand list of special status species.
- Develop a long-term habitat management plan.
- Assess the requirements needed to maintain wildlife diversity and integrity (GAP analysis).

cont'd

## Agency and or Facility

**EPA, USACOE, USFWS, NRCS, NBS**

**USDA/NRCS and Landowners**

**RAP Implementation Committee**

**BPAC**

**RAP Implementation Committee  
and BPAC**

**RAP Implementation Committee**

**BPAC**

**LIS**

**OMOEE and MDNR**

**All Agencies**

**RAP Team, BPAC, OMOEE, OMNR, MDNR,  
Environment Canada, EPA**

**RAP Implementation Committee**

## Action

### H A B I T A T

- Strengthen wetland protection measures.
  - Undertake identified habitat restoration and enhancement projects; expand candidate sites; maximize fish use of delta habitats; encourage maintenance/enhancement of riparian vegetation; improve co-ordination amongst conservation/protection agencies; expand list of special status species.
  - Develop a long-term habitat management plan.
  - Assess the requirements needed to maintain wildlife diversity and integrity (GAP analysis).
  - Develop and implement communications/education programs and appropriate landowner guidelines.
- 
- Ensure protection of shorelines from erosion and protect/enhance/restore other natural habitats in the watershed.
- 
- Develop and implement communications/education programs and appropriate landowner guidelines.
  - Undertake identified habitat restoration and enhancement projects; expand candidate sites; maximize fish use of delta habitats; encourage maintenance/enhancement of riparian vegetation; improve co-ordination amongst conservation/protection agencies; expand list of special status species.
- 
- Develop and implement communications/education programs and appropriate landowner guidelines.
- 

### P U B L I C E D U C A T I O N A N D O U T R E A C H

- Develop and implement a public involvement program.
  - Develop and implement public outreach and education programs.
- 

### M O N I T O R I N G A N D R E S E A R C H

- Develop detailed monitoring workplans.
  - Complete GIS analytical spatial database.
  - Implement monitoring programs and update GIS database.
- 
- Develop detailed monitoring workplans.
- 
- Implement monitoring programs and update GIS database.
- 
- Acquire additional information to improve modelling accuracy.
- 
- Implement monitoring programs and update GIS database.
- 

### R A P I M P L E M E N T A T I O N

- Establish RAP Implementation (RIC) and Public Accountability Committees.
- 
- Complete implementation workplan.
-

*Information presented in this chapter is taken primarily from the Stage 1 Remedial Action Plan (RAP) Report (OMOEE/MDNR 1991) as updated in the Stage 1 Addendum Report (OMOEE/MDNR 1993).*

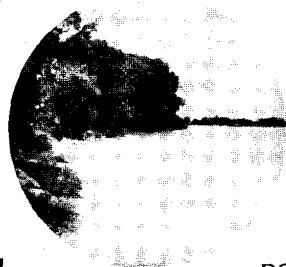
## ● 2.1 Area of Concern Characteristics

**T**he St. Clair River serves as a channel connecting Lake Huron with Lake St. Clair. It flows in a southerly direction from Lake Huron and, prior to entering Lake St. Clair, the river divides into several channels creating an extensive delta known as the St. Clair Delta or St. Clair Flats. The Area of Concern (AOC) consists primarily of the main river and its delta channels, however, for purposes of the RAP, the study area includes both coastal watersheds. Figure 2.1 illustrates the major land uses and land cover in Ontario and Michigan. Figure 2.2 shows the extent of the St. Clair River watershed and the extent of existing and historical wetlands within the St. Clair River watershed.

In Ontario, 78% of the immediate drainage area of the St. Clair River AOC is agricultural and in Michigan, 68% is dedicated to agriculture. While urban areas such as Sarnia and Port Huron are home to a large number of people, a significant portion of the population remains in rural areas. A relatively small portion of the land bordering the St. Clair River is forested. There is a concentration of industry in the upper portion of the river between Lake Huron and Fawn Island, including petroleum refineries, organic and inorganic chemical manufacturers, paper companies, salt producer and thermal electric generating facilities. The Stage 2 RAP identifies 40 sites of environmental contamination (23 Ontario industrial waste sites; 4 Ontario municipal landfills; 9 Michigan waste sites; and 4 Michigan leaking underground storage tanks) in the watershed that require further assessment and/or clean-up. Two native Indian reserves are

situated along the Canadian shore - the Chippewas of Sarnia Band Reserve and the Walpole Island First Nation Reserve.

The St. Clair River serves as a shipping channel for a number of industries and the broader Great Lakes Seaway system. It is also a source of cooling and process water for industry and thermal generating stations. It serves as drinking water for a population of approximately 170,000. The wetlands and associated open waters of the lower St. Clair River and Lake St. Clair comprise one of the most important wetland areas in the Great Lakes Region (Figure 2.2). They provide an important habitat for ducks, geese and swans. The AOC supports 91 fish species, 20 species of amphibians, 25 species of reptiles, 250 species of birds and 60 mammal species. Currently, commercial fishing within the St. Clair River is considered negligible. Sport fishing, however, is popular on the St. Clair River, and hunting and trapping are significant uses, particularly for the native people living on the River. The River also supports a number of parks and areas affording opportunities including swimming, boating and naturalist activities.



## ● 2.2 Impairment of Beneficial Uses

The St. Clair River was identified as an AOC because of exceedences of general or specific objectives of the Great Lakes Water Agreement, responsible for impairment of 9 of the 14 beneficial uses recognized under the Great Lakes Water Quality Agreement (GLWQA). These impairments occur as the result of physical disruption of habitat and/or elevated contaminant levels in the water, sediment and biota of the St. Clair River. Table 2.1 summarizes the status of impairments of beneficial uses.

Contaminants of concern which have exceeded Ontario, Michigan or GLWQA objectives/standards for water, sediment or biota include:

| <b>Metals</b> | <b>Conventional Pollutants</b> | <b>Organic Contaminants</b>               |
|---------------|--------------------------------|-------------------------------------------|
| • arsenic     | • oil and grease               | • octachlorostyrene                       |
| • cadmium     | • TKN                          | • hexachlorobenzene                       |
| • copper      | • total phosphorus             | • hexachlorobutadiene                     |
| • chromium    | • bacteria                     | • tetrachloroethylene                     |
| • iron        | • chloride                     | • carbon tetrachloride                    |
| • lead        | • phenols                      | • dieldrin                                |
| • manganese   |                                | • polychlorinated biphenyls (PCBs)        |
| • mercury     |                                | • polycyclic aromatic hydrocarbons (PAHs) |
| • nickel      |                                | • polychlorinated dioxins and furans      |
| • zinc        |                                |                                           |

In addition to the contaminants of concern noted above, several additional parameters known to occur in the St. Clair River have been identified in Ontario's Effluent Monitoring Priority Pollutants List (EMPPL) as having one or more of the following characteristics: persistence, potential to bioaccumulate, and potential acute and sublethal toxicity to biological organisms including humans. These include:

|                          |                                    |
|--------------------------|------------------------------------|
| • Benzene                | • Pentachlorobenzene               |
| • Toluene                | • Chlorophenols                    |
| • Xylene                 | • 1,1- and 1,2-Dichloroethane      |
| • Trichloroethylene      | • Hexachloroethane                 |
| • 2,4,5-Trichlorotoluene | • 1,1,1- and 1,1,2-Trichloroethane |

The primary sources of contaminants to the St. Clair River are industrial and municipal point sources and urban and rural non-point sources.

## ▲ 2.3 Point Sources and Related Impacts

Municipal point sources were identified in the Stage 1 RAP Report as significant contributors of conventional, metal and organic contaminants to the St. Clair River. There are four municipal water pollution control plants (WPCP) and two lagoons which discharge within the Ontario portion of the St. Clair River. In Michigan, there are six municipal Waste Water Treatment Plants (WWTP) and three municipal wastewater stabilization lagoon systems (see Chapter 4).

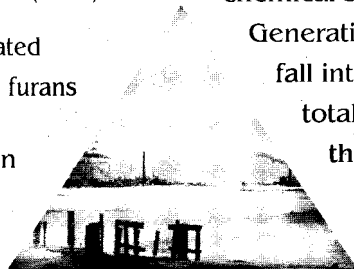
Industrial point sources were identified as a significant contributor of conventional and metal contaminants and as the primary contributor of most organic contaminants. Industrial sources of pollutants to the St. Clair River in Ontario originate primarily from the petroleum, inorganic chemical, and the organic chemical sectors. Ontario Hydro's Lambton Thermal Generating Station is the only facility that does not fall into one of the three categories mentioned. In total, there are 27 industrial facilities in Ontario that discharge effluents directly or indirectly into the St. Clair River (see Chapter 4).

Indirect discharges are to the Cole Drain (Cut-Off Drain), the Scott Road Drain, the Allingham Drain, Talfourd Creek, or Baby Creek, which in turn flow into the St. Clair River.

Table 2.2 summarizes the impairment of beneficial uses according to the industrial sectors as well as other sources.

There are six major industrial direct dischargers to the St. Clair River in Michigan. These include three thermal hydro electric stations, a salt processor, and two paper companies (see Chapter 4).

Atmospheric deposition monitoring undertaken at Walpole Island and air quality monitoring within the Sarnia area indicate that several organic and metal contaminants, as well as particulates and sulphur dioxide, are contributed to the AOC via atmospheric pathways. Air quality standards were exceeded in the



# Location of St. Clair River RAP Study Area and Major Land Uses

FIGURE 2.1



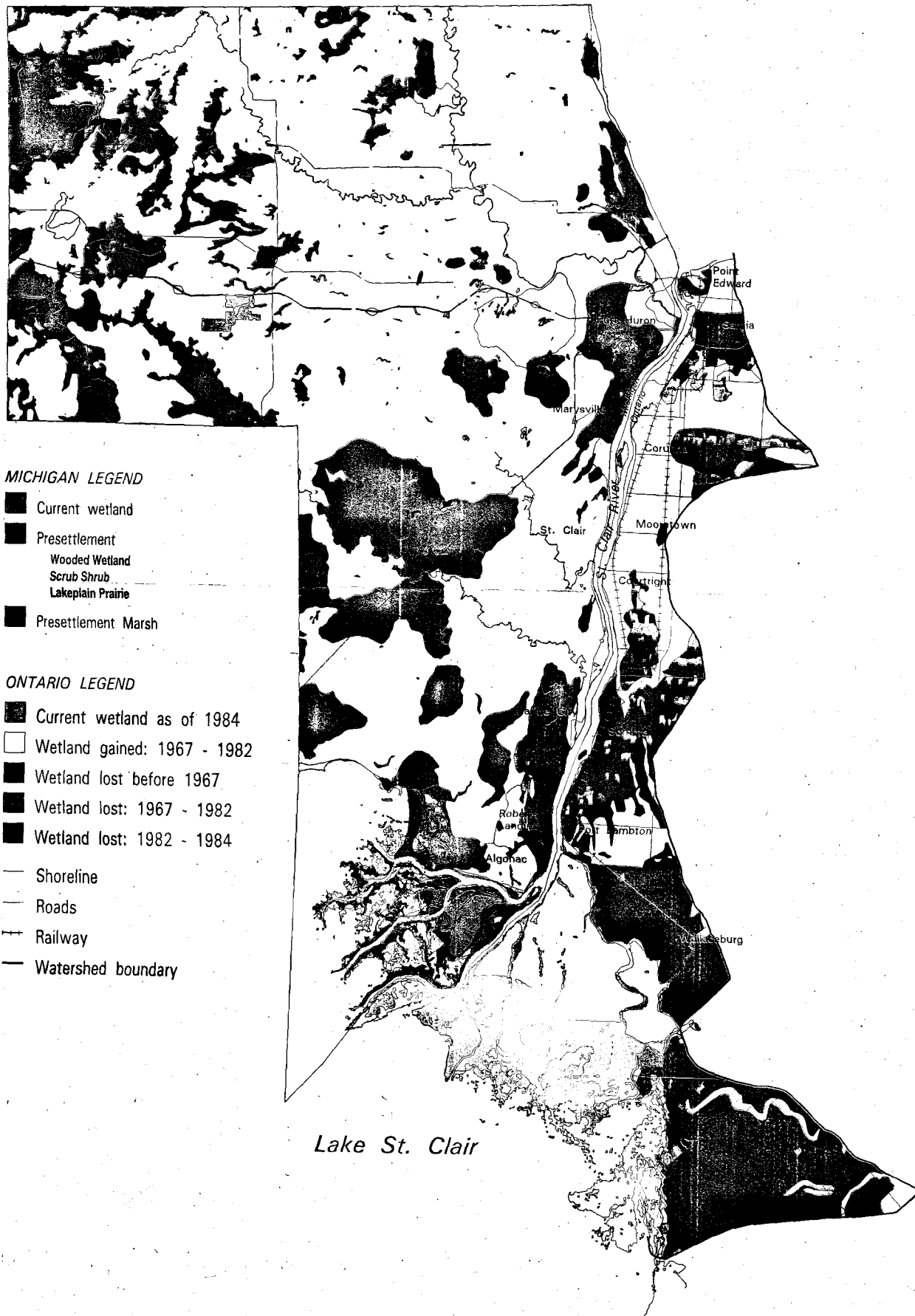
- Cultivated Land
- Hay/Pasture/Open Grass Areas/Fallow Field
- Late Successional Field/Thicket
- Woodlots/Forested Land
- Urban/Residential/Roads
- Industrial
- Deep Emergent Typha Marsh
- Reed Marsh
- Offshore Emergent/Submergent Wetland
- Shallow Water and/or Suspended Sediment
- Water

Land use classes derived from LANDSAT Thematic Mapper satellite image acquired June 13, 1993.

1:250,000 Scale

# Extent of Existing and Historical Wetlands within the St. Clair River Watershed

FIGURE 2.3



# Summary of Impairments to Great Lakes Water Quality Agreement Beneficial Uses Within the St. Clair River AOC.

Impairment status is defined as impaired (I), not impaired (NI) or requires further assessment on a site specific basis (A) or on a Great Lakes Basin basis (B) and is based on data collected over the period 1983 through 1993 (from OMOEE/MONR 1993), and subsequently.

## GLWQA Impairment of Beneficial Use

Status of  
Impairment

## Conditions in the St. Clair River

### Restrictions on Fish and Wildlife Consumption

#### Restrictions on Fish Consumption

- I Fish consumption advisories currently in effect are:
- Ontario - mercury: walleye, white sucker, freshwater drum and yellow perch  
- PCBs: carp and gizzard shad  
- dioxins and furans (2,3,7,8-TCDD(TEQ)): carp
- Mich. - mercury: freshwater drum  
- PCBs: gizzard shad and carp

#### Consumption of Wildlife

- B There are currently no guidelines directly applicable to the St. Clair River AOC regarding human consumption of wildlife. However, concentrations of PCBs in snapping turtles as well as octachlorostyrene, hexachlorobenzene and PCBs in mallards and redheads, which are utilized by human consumers such as residents of the Walpole Island First Nations Band, highlight the need for these guidelines. The Ontario Ministry of Natural Resources has issued a warning for people to use prudence with respect to the regular consumption of turtle meat from some areas including Walpole Island due to PCBs.

### Tainting of Fish and Wildlife Flavour

- A There have been anecdotal reports of tainting.

### Degradation of Fish and Wildlife Populations

#### Dynamics of Fish Populations

- NI The fish fauna of the St. Clair River are considered diverse and well-balanced. RAP will assess quantitative fish community goals being prepared by OMNR to determine the potential for further improvements in the fishery. The impairment status will be re-evaluated in light of this new information.

#### Body burdens of Fish

- B Several contaminants including mercury, PCBs, hexachlorobenzene and octachlorostyrene have been found in adult and juvenile fish on the Ontario side of the river and in the St. Clair Delta. Effects of these chemicals on fish are not known. Research on body burdens and associated effects in fish is required for the entire Great Lakes ecosystem.

#### Dynamics of Wildlife Populations

- A The use of the wetlands of the St. Clair Delta by true marsh-dwelling waterfowl species declined by 79 percent (spring) and 41 percent (autumn) between 1968 and 1982 due to the loss of wetlands. Peak counts of migrating ducks in U.S. waters of Lake St. Clair averaged less than 50,000 from 1982 through 1988. Peak counts from 1989 through 1993 averaged less than 100,000. Continent wide wetland loss is a factor to migrating bird survival, but this has not been assessed for wetland species in the AOC. Guidelines for the protection of fish-eating wildlife have been exceeded in shiners, gizzard shad, carp and walleye for PCBs and in shiners for octachlorostyrene. The effects of these exceedences, if any, on wildlife populations which consume these fish are not known.

#### Body burdens of Wildlife

- B Contaminants such as pentachlorobenzene, hexachlorobenzene, octachlorostyrene, PCBs and DDT have been found in snapping turtles, muskrats and ducks in the St. Clair Delta. The effects of these chemicals on wildlife are not fully understood. Research on body burdens and associated effects in wildlife is required for the entire Great Lakes ecosystem.

### Fish Tumours and Other Deformities

- A There is a growing consensus that there is sufficient evidence to suggest liver tumours are caused by chemical factors. For this reason additional studies are required. Studies were conducted in 1994 and results are pending.

### Bird or Animal Deformities or Reproductive Problems

- I Mouth part anomalies occur in some chironomid species but no evidence of bird or other animal deformities or reproductive problems has been reported.

cont'd

## GLWQA Impairment of Beneficial Use

Status of  
Impairment

## Conditions in the St. Clair River

### Degradation of Benthos

Dynamics of Benthic Populations/  
Communities

Body Burdens of Benthic Organisms

### Restrictions on Dredging Activities

### Eutrophication or Undesirable Algae

### Restrictions on Drinking Water Consumption or Taste and Odour Problems

Consumption

Taste and Odour Problems

### Beach Closings

### Degradation of Aesthetics

### Added Cost to Agriculture or Industry

### Degradation of Phytoplankton and Zooplankton Populations

### Loss of Fish and Wildlife Habitat

- |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| I  | Benthic community health is good on the Michigan side of the river but, as of 1990, was "degraded" or "impaired" in a series of seven short segments along the Ontario shore for a total distance of about 6 km, or about half the distance identified from the 1985 survey. The "severely degraded" zone was not found in the 1990 survey.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| B  | Several types of benthic organisms, including native clams, mayflies, aquatic worms (Oligochaetes) have been found to bioaccumulate various organic and inorganic chemicals. The effects of these chemicals on benthic organisms is not known. Research on body burdens and associated effects in benthic organisms is required for the entire Great Lakes ecosystem.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| I  | Concentrations of arsenic, copper, cadmium, chromium, iron, lead, mercury, nickel, zinc, total PCBs, total PAHs, hexachlorobenzene, total organic carbon, TKN, total phosphorus and oil and grease along the Ontario shoreline exceed PSQG and/or U.S. EPA interim guidelines for the Disposal of Great Lakes Harbour Sediments. Most exceedences occur along the Sarnia industrial waterfront, as far downstream as the Lambton Generating Station, and the mouths of Talfourd Creek, Baby Creek and the Murphy Drain. Confined disposal has been required in some instances due to the presence of HCB. Concentrations of total Kjeldahl nitrogen, oil and grease, arsenic, copper, chromium, iron, lead and manganese from the Michigan shore are considered moderately or heavily polluted by U.S. EPA guidelines and exceed OMOEE disposal guidelines or PSQG. |
| NI | The waters of the St. Clair River are mesotrophic and algae do not occur at nuisance levels.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| I  | Periodic closing of Water Filtration/Treatment Plants occur in both Michigan and Ontario as a result of chemical spills at upstream locations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| I  | The Health and Welfare Canada taste and odour aesthetic objective for ethylbenzene was exceeded at the Wallaceburg Water Treatment Plant during start-up following a spill in October 1990. Closures of the Wallaceburg WTP intakes based on level II responses are based on factors including taste and odour concerns.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| I  | No beach closings occurred in Michigan in 1992 and 1993, however there were several in 1994. All areas downstream of Michigan CSOs are identified as impaired areas due to the periodic discharge of inadequately treated sewage. In Ontario, five beaches were closed in the summer of 1990 for up to two months duration due to coliform bacteria levels which exceeded both Ontario and Michigan standards. Caution signs, warning against high bacterial levels after a rainfall, have been posted on all Ontario beaches along the St. Clair River since 1991. Routine sampling for bacteria levels in Ontario waters recommenced in 1994.                                                                                                                                                                                                                     |
| I  | Floating scums, oil slicks, spills and odours have been periodically reported.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| I  | Food processing industries in Ontario and a salt processing facility in Michigan have had to temporarily shut down their intakes due to upstream spills. Costs have also been incurred for proper disposal of contaminated sediment removed from the river for construction or other purposes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| NI | Phytoplankton and zooplankton species in the river are typical of those in southern Lake Huron.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| I  | Habitat has been lost due to filling, draining, dredging and bulkheading for industrial, urban, agricultural and navigational uses. Significant losses of wetlands have occurred particularly in the delta region of the AOC.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

1 The Impairment Status 'requires assessment' in the St. Clair River AOC.  
2 The Impairment Status 'requires assessment' on a Great Lakes Basin basis.

# Use Impairments and Contaminants Associated with Sources in the St. Clair River Watershed

(modified from Beak 1993, Table 3.7.1).

| Impairments of Beneficial Use                                                 | Associated Contaminants                                                                                                                        | Associated Source                                                                                   |
|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| <b>Restrictions on Fish and Wildlife Consumption</b>                          | PCBs, mercury, hexachlorobenzene, dioxins and furans                                                                                           | discharges from inorganic/ organic chemicals, stormwater, WWTPs, WPCPs                              |
| <b>Bird or Animal Deformities or Reproductive Problems</b>                    | further assessment required                                                                                                                    | data gap                                                                                            |
| <b>Degradation of Benthos</b>                                                 | heavy metals, chlorinated organics, benzene, oil and grease, ethylbenzene, styrene, PAHs                                                       | discharges from organic and inorganic chemicals, WPCPs, WWTPs, petroleum refining, CSOs, stormwater |
| <b>Restrictions on Dredging Activities</b>                                    | PCBs, mercury, chromium, copper, iron, nickel, PAHs phosphorous, arsenic, cadmium, lead, zinc, oil and grease, chlorinated organics, zinc, TKN | discharges from organic/inorganic chemicals, WPCPs, WWTPs, petroleum refining                       |
| <b>Restrictions on Drinking Water Consumption or Taste and Odour Problems</b> | chemical spills                                                                                                                                | discharges from organic and inorganic chemicals, petroleum refining, indirect discharges            |
| <b>Degradation of Aesthetics</b>                                              | scums, oil and grease, spills                                                                                                                  | point sources, CSOs                                                                                 |
| <b>Added Cost to Agriculture or Industry</b>                                  | spills                                                                                                                                         | point sources                                                                                       |
| <b>Loss of Fish and Wildlife Habitat</b>                                      | filling, draining and dredging activities; loss of wetlands                                                                                    | industrial, municipal, agricultural, and navigational                                               |
| <b>Beach Closings</b>                                                         | bacteria                                                                                                                                       | WPCPs, CSOs, rural runoff, domestic sanitary sources, wildlife, pleasure craft                      |

Sarnia area during 1990 or 1991 for a number of parameters including sulphur dioxide, ethylene, total reduced sulphur, ozone, and average annual particulate. However, it should be noted that ethylene and ozone are unlikely to affect the water quality in the AOC (pers. comm. Dr. P.K. Misra, OMOEE Air Quality and Meteorology Section, Etobicoke).

In Michigan, two total suspended particulate air monitors in St. Clair County each recorded only one value greater than 150 g/m<sup>3</sup> during 1992. A continuous sulphur dioxide monitor in Port Huron has indicated that there have been no sulphur dioxide exceedences since 1977. Ozone monitors in Port Huron and Clay Township (near Algonac) indicated no exceedences of the health-related ozone standard

during 1992. In 1991 only two ozone exceedences were recorded at Port Huron and three exceedences at Algonac.

## Spills

Potential sources of spills include industrial and municipal sources, ships, vehicles crossing the Blue Water Bridge, railcars and petroleum pipelines which cross the river. The total number of spills to the St. Clair River from Ontario industries did not change substantially from 1986 to 1989 at over 100 spills per year. Since then, the incidence and volume of spills have declined dramatically due to the implementation of spill prevention and contingency measures with 84 industrial spills occurring in 1990; 65 in 1991; 37 in 1992; and 26 in 1993.

The largest group of pollutants spilled to the river from all Ontario sources are oil and gasoline products and organics representing a range of substances such as alcohols, benzene/toluene/ xylene, chlorinated hydrocarbons, ethylene glycol, and petroleum oil. Loadings of ammonia and ammonia-contaminated material and brine wastes are also spilled to the river each year. Raw and treated sewage have been discharged from municipal WPCPs as well as activated sludge from industry. Spills of other contaminants of concern tend to be quite low.

Spills and other environmental affronts from Michigan sources are reported to the MDNR Pollution Emergency Alert System (PEAS). Between November 1986 and June 1990, 187 complaints potentially affecting the St. Clair River or its tributaries were made through PEAS. Known to be released were 26,330 kg (58,047 lbs) of chemicals and 2,180,769 L (576,159 U.S. gal) of various other pollutants. The most commonly spilled substances from Michigan sources included oils and greases, sewage, and various solvents (*i.e.* gasoline). From January 1993 through April 1994, 14 complaints (excluding CSOs) of spills, scums, oozes and sheens on the St. Clair River and tributaries were reported. Substances included diesel fuel (10 U.S. gal) (37.85 L), gasoline (50 U.S. gal) (189.25 L), sewage from individual residences and salt pile runoff. During this period two industries, James River Corporation and E.B. Eddy reported spills of paper fibre (100 lbs) (45.36 kg) and process water (15,000 U.S. gal) (56,775 L), respectively.



## ■ 2.4 Non-Point Sources and Related Impacts

### Urban Stormwater

Urban areas represent a significant non-point source of contaminant loading to the St. Clair River. Loadings from Ontario urban areas generally account for greater than 10% of the total contaminant loading. Contaminants associated with the

Ontario urban areas and which may result in use impairments include iron, lead, zinc, oil and grease, hexachlorobenzene, total PAHs and total PCBs.

The largest Ontario and Michigan urban areas within the St. Clair River AOC, including size and population, are listed below:

|                               | Area (Ha) | Population |
|-------------------------------|-----------|------------|
| • Moore Township              | 31,781    | 10,432     |
| • Village of Point Edward     | 352       | 2,323      |
| • City of Sarnia              | 16,406    | 72,684     |
| • Sombra Township             | 29,932    | 4,053      |
| • Town of Wallaceburg         | 1,068     | 11,684     |
| • Walpole Island First Nation | 15,891    | 1,658      |
| • Chippewas of Sarnia         | 1,315     | 487        |
| • Port Huron                  | 33,670    | 33,694     |
| • Marysville                  | 20,720    | 8,515      |
| • St. Clair                   | 7,252     | 5,116      |
| • Marine City                 | 5,568     | 4,556      |
| • Algonac                     | 14,763    | 4,551      |

Contamination from urban areas can be attributed primarily to urban stormwater discharges, combined sewer overflows, and malfunctioning septic systems. Discharges from storm sewers can be a major source of pollutant loadings due to washoff of accumulated contaminants. Sources of these contaminants include nutrients and pesticides spread on lawns, heavy metals and exhaust emissions from automobiles, sediment from construction sites, petroleum and chemical spills in industrial areas, bacterial contamination from fecal droppings of domestic pets and birds, atmospheric deposition, and direct or indirect connections with sanitary sewers. Connections from the sanitary sewer systems contribute to contaminant flows not only during wet weather, but also during dry weather conditions.

Overflows which include sanitary and combined sewage overflows within the system, as well as pumping station overflows, are generally caused by

larger rainfall events. The City of Sarnia is the only Ontario municipality within the St. Clair watershed with combined sewer overflows. Based on 1987 monitoring, there are approximately 108 combined sewer overflows per year for the four Sarnia CSOs discharging directly to the St. Clair River.

The Cities of Port Huron and Marysville currently have combined sewer overflows. From January 1993 through April 1994, Port Huron reported 8 overflows; and Marysville estimates 12 overflows per year. Marysville has separated sewers comprising one outfall and will complete sewer separation by 2001. Port Huron's CSO control plan is currently being negotiated with MDNR. St. Clair, Marine City, Capac and Yale combined sewers have been separated and are undergoing final testing and certification.

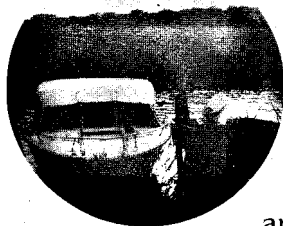
Septic systems release untreated contaminants into the groundwater system. The primary concern is the infiltration of the septic waters into the storm sewer system, groundwater and/or surface water.

### **Rural Runoff**

Rural non-point pollution due to agricultural operations include nutrients (manure and commercial fertilizers), sediment from land erosion, and inputs of insecticides, herbicides and fungicides. Pesticides entering the tributaries are a contaminant of concern and agricultural drainage is a source of disruption to habitat and to wetland size and integrity.

Agricultural operations in Ontario focus on cash cropping, beef and swine operations. The area's long growing season and fertile soils easily support the principal cash crops of soybeans, corn, wheat, hay and cereals. In Michigan, agricultural operations consist primarily of cash cropping, dairy and beef operations. Soils on both sides of the river are typically fine grained (silts and clays) which tend to adsorb contaminants and can be transported long distances.

Ontario tributaries have been found to contribute pesticides including atrazine,  $\delta$ -BHC,  $\gamma$ -BHC, dieldrin,  $\delta$ -endosulphan, p,p'DDE, p,p'DDD, p,p'DDT, endrin and methoxychlor. Dieldrin is the only pesticide which has been found to exceed water quality guidelines in the AOC. The total loading of dieldrin from Ontario tributaries, based on instantaneous loadings is 0.000118 kg/d. Contamination by dieldrin is widespread and likely includes upstream sources since it is detected in all tributaries. It does not degrade quickly and, thus, may be more representative of historical usage. In Canada dieldrin registration under the *Pest Control Products Act* was discontinued in 1990. Manufacture and importation was not permitted but existing stocks could be used. In practice, little has been used since the mid 1970s. Ontario announced a ban on the use of dieldrin in 1993.

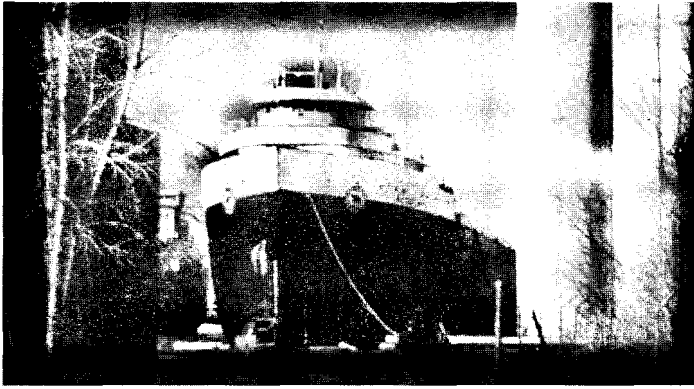


### **Waste Disposal Sites**

Contaminants from waste disposal sites may be transported to the St. Clair River through groundwater pathways and/or surface water runoff. Contaminant loads from waste sites have not been measured and therefore impacts on the St. Clair River are unknown. There are twenty-three industrial and four municipal waste sites within the Ontario portion of the AOC. There are nine known waste sites and four known leaking underground storage tanks in the Michigan watershed which require further assessment and possible cleanup. These sites have some potential for surface water contamination and are listed on the Priority List for EVALUATION AND INTERIM RESPONSE under Act 307.

## ● 2.5 Sediments

Bottom sediments along the Ontario shoreline of the St. Clair River have been severely contaminated with a variety of inorganic and organic chemicals from industrial, municipal and non-point sources. Severe impairment of the benthic community was found



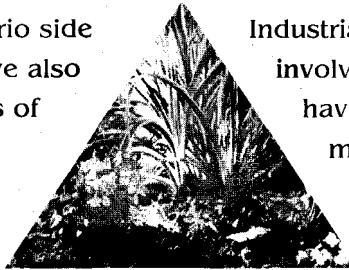
along the entire Ontario shoreline in 1968. Since then, the benthic communities have improved significantly such that in 1977 the zone of severe community impairment was only 21 km in length; in 1985, 12 km; and totalling about 6 km in 1990.

The distribution of contaminants in the sediments of the St. Clair River is strongly related to industrial and municipal point sources on the Ontario side of the River. Urban non-point sources have also been identified as significant contributors of metals and some organic contaminants. Resuspended sediment represents an in-situ source of contaminants to the water column which may be available to the biological community depending upon the physical and chemical conditions and species.

The zones of elevated contaminant levels are found along the Ontario shoreline from the Sarnia industrial area to downstream of Stag Island (Table 2.1). The distribution of individual contaminants through this reach of the river generally reflects the current and historical effluent characteristics of individual point sources. Sediments associated with the petrochemical industries have been found to be acutely lethal to minnows and mayflies. Although benthic communities on the Michigan side of the river are healthy, there are exceedences of yardsticks for certain metals in bottom sediment (Table 2.1) near Port Huron, St. Clair and Algonac.

## ▲ 2.6 Habitat

The loss of wetland resources and other fish and wildlife habitat is considered a major concern within the AOC. Wetlands have been lost by drainage of land for agricultural purposes; dredging or filling for navigation, marina and housing developments; and hydrologically separating wetlands from the main channel. Quantitative estimates of wetland loss indicate that, on the Michigan side, a 72% decrease in aerial extent between 1873 and 1973 occurred while in Ontario 2,630 acres (1,064.36 ha) were lost between 1965 and 1984 from the mouth of the Thames River to Chenal Ecarte, including channels of the Walpole Island First Nation Reserve. Agricultural drainage accounted for 92% of the losses. Marine and cottage development has accounted for the remaining portion (8%) of the loss of wetland.



Industrial, agricultural and urban development, involving extensive bulkheading and infilling, have altered shoreline configurations and minimized spawning, rearing and feeding sites of many fish species. The delta area has seen increased use by waterfowl species in general (between 1968-

1982), but a decrease in use by diving ducks specifically during the fall season. Spring use of the area has seen little change in terms of peak numbers of waterfowl, but a decrease of 79% for dabbling ducks is documented as occurring between 1968 and 1982. Peak counts of migrating waterfowl in U.S. waters of Lake St. Clair averaged less than 50,000 ducks with a high peak count of 51,130 in autumn of 1988 and a low of 32,000 in 1986. Waterfowl counts have been on the increase since 1989. Peak counts range from a low in 1989 of 52,630 to a high in 1991 of 209,000. Peak counts from 1989 through 1993 averaged just under 100,000.

Reduction in waterfowl in the 1960s, 1970s and early 1980s may be attributed to: drainage and the subsequent loss of wetlands; boat traffic; hunting; and local or continental population declines of certain species.

### ■ 3.1 RAP Water Use Goals and Objectives

**R**AP goals and objectives were prepared following the release of the Stage 1 report in December, 1991. They were prepared in response to the specific environmental problems defined in the Stage 1 document and are consistent with the provisions of Annex 2 of the GLWQA. The goals and objectives were developed so as to be consistent with the standards, objectives, criteria, regulations and policies of OMOEE and MDNR.

They were developed jointly between the Binational Public Advisory Committee (BPAC) and Remedial Action Plan (RAP) Team through a series of workshops. The first was a one day Water Use Goals workshop held in May, 1992. This was followed by a series of Objectives Setting workshops. Draft water use goals and specific objectives were then reviewed, prioritized and ratified at a combined workshop in November, 1992. These were revised following public review and the final water use goals and objectives were formally released on January 14, 1993.

The specific time frame for achieving the goals varies and will be determined by the work required. The goals are consistent with the intent of the Great Lakes Water Quality Agreement (GLWQA), to restore, protect and maintain beneficial water uses, as well as the chemical, physical and biological integrity of the St. Clair River and delta. In addition to the specific RAP goals, the St. Clair River RAP recognizes the obligations under the GLWQA to strive for virtual elimination within a philosophy of zero discharge of persistent toxic substances.

The water use goals and objectives defined by the RAP Team and BPAC are as follows:

#### **Aesthetics**

**Achieve and maintain an aesthetically pleasing clean "blue water" and an appropriate balance of natural shoreline and human uses.**

**There should be sufficient public access to the river for recreation, enjoyment and cultural activities.**

#### **Consumption of Fish and Wildlife**

**Eliminate the need for restrictions on human consumption of fish and wildlife for reasons of health.**

##### **Objective A.**

*Human Consumption: By the year 2000, levels of contaminants in fish and wildlife attributable to sources in the AOC will not pose a health hazard to humans based on consumption guidelines.*



#### **Ecosystem Health**

**Attain and maintain healthy, diverse and self-sustaining biological communities and habitats.**

**Ensure there are no negative impacts on the health of local populations due to water quality.**

**Ensure no net loss of fish and wildlife habitat and reclaim, rehabilitate and enhance habitat where possible.**

##### **Objective B.**

*Wetland & Aquatic Habitats: By the year 2000, protection of existing (1992) habitat and enhancement and appropriate increase of sustainable, viable wetland and aquatic habitats will be achieved.*

##### **Objective C.**

*Ecosystem Improvements: By the year 2000, we will demonstrate improvements in ecosystem health through:*

*-reductions in body burdens of persistent bioaccumulative substances to a level below established effect levels;*

-enhancement of abundance and species diversity;

-establishing that no exceptional incidences of tumours or deformities are evident in fish and wildlife populations; and

-achievement of environmental yardsticks, e.g., water and sediment.

### **Recreation and Shipping**

**Ensure that the water quality is safe for body contact at all times.**

**Eliminate adverse environmental effects caused by recreational and shipping activities.**

#### **Objective D.**

*Recreation: By the year 2000, consistently acceptable water quality and access for recreational uses such as swimming, fishing, boating and aesthetic enjoyment will be provided.*

### **Sources of Contaminants**

**Ensure that no source (point or non-point) impairs water quality.**

**Eliminate spills.**

#### **Objective E.**

*Point Sources (including shipping): By the year 2000, there will be top quality river water as measured against ambient water quality objectives in the AOC through pollution prevention activities and effective control of industrial, municipal, shipping, air and water discharges.*

#### **Objective F.**

*Non-Point Sources: By the year 2000, all urban and rural non-point sources (e.g., sources of herbicides/insecticides, soil, nutrients (fertilizers/animal & human waste), bacteria, and input to storm sewers, lawn runoff, septic systems, storm runoff) will be controlled to achieve the overall goals of the RAP.*

#### **Objective G.**

*Sediments: By the year 2000, river sediments and associated contaminants will not impair identified beneficial uses.*

#### **Objective H.**

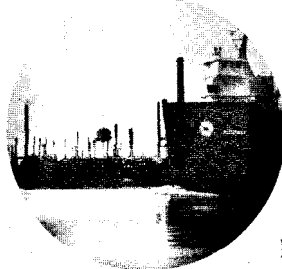
*Exotic Species: By the year 2000, the introduction of nuisance exotic species will have been prevented and their expansion will have been controlled.*

### **Water Supply**

**Ensure that an adequate and affordable water supply, in quality and quantity, is available from the St. Clair River for users at all times.**

#### **Objective I.**

*Water Quality and Quantity: By the year 2000, river water meeting quality criteria for municipal, industrial, agricultural and residential non-drinking uses, and as a drinking water source using normal treatment processes, will be available without interruption.*



## **3.2 Delisting Criteria**

In order to guide the development of remedial and preventative options, implementation of the RAP and targeted monitoring programs, it is necessary to determine benchmark conditions which will result in the "delisting" of each impairment to beneficial uses. The RAP Team for the St. Clair River AOC has developed specific delisting criteria for each of the nine impairments to beneficial uses determined in the Stage 1 problem definition. These guidelines are presented in Table 3.1. They were developed by tailoring the delisting criteria developed by the IJC for Great Lakes AOC, to the specific St. Clair River impairments as defined in the Stage 1 Report, Addendum Report and subsequently.

# St. Clair River AOC Delisting Criteria For Each Impaired Use and Relationship to RAP Goals and Objectives

| Impairments of Beneficial Use                                          | Delisting Guideline                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | RAP Goals and Objectives                                                                    |
|------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| Restrictions on fish and wildlife consumption                          | When contaminant levels in fish and wildlife populations do not exceed current standards, objectives or guidelines and no public health advisories are in effect for human consumption of fish and wildlife.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Consumption of fish and wildlife (A)<br>Recreation and shipping (D)<br>Ecosystem health (C) |
| Bird or animal deformities or reproductive problems                    | When chironomid mouthpart anomalies occur at rates similar to incidences in "control" populations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Ecosystem health (C)                                                                        |
| Degradation of benthos                                                 | When invertebrate community structure can be documented as unimpaired or intermediate as defined by recent OMOEE benthic investigations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Ecosystem health (C)<br>Sources of contaminants (E, F, G)                                   |
| Restrictions on dredging activities.                                   | No limitations on disposal of dredging spoils.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Sources of contaminants (E, F, G)<br>Ecosystem health (C)                                   |
| Restrictions on drinking water consumption or taste and odour problems | No treatment plant shutdowns due to exceedences of drinking water guidelines over a two year period.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Water supply (I)<br>Sources of contaminants (E)                                             |
| Beach closings                                                         | Zero beach closings based on standards regulating beach closings over a two year period.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Recreation and shipping (D)<br>Sources of contaminants (E)<br>Ecosystem health (C)          |
| Degradation of aesthetics                                              | When over a two year period there are no objectionable deposits, unnatural colour or turbidity, unnatural odour or unnatural scum/floating materials.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Aesthetics<br>Sources of contaminants (E)                                                   |
| Added costs to agriculture or industry                                 | No plant shutdowns attributable to water quality over a two year period.<br>No added costs for the disposal of contaminated sediments.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Water supply (I)                                                                            |
| Loss of fish and wildlife habitat.                                     | <p>Protection:</p> <ol style="list-style-type: none"> <li>1. Regulations - Ensure that sufficient enforceable mechanisms are in place to protect existing aquatic and wetland habitat from cultural destruction or degradation, including filling, dredging, adversely affecting the hydrology, cutting or removing vegetation required for habitat, and allowing pollutants such as sediment, excess nutrients or toxic substances to enter aquatic or wetland habitat.</li> <li>2. Acquisition - Acquire into public ownership an additional 800 acres (324 ha) of wetland habitat in Michigan by the year 2000.</li> <li>3. Protect existing habitat in Ontario.</li> </ol> <p>Restoration and Enhancement:</p> <ol style="list-style-type: none"> <li>1. Of the 5,200 ha (12,844 acres) identified as "Candidate Sites" in Ontario, complete the following habitat rehabilitation projects by the year 2000: <ul style="list-style-type: none"> <li>• Chenal Ecarté Wetland Creation (155 ha) (384 acres)</li> <li>• Stag Island (80 ha) (198 acres)</li> <li>• Darcy McKeough Floodway (445 ha) (1,100 acres)</li> </ul> </li> <li>2. Reclaim and restore 200 acres (81 ha) of Michigan state-owned public bottomlands currently in private use by the year 2000.</li> <li>3. Restore an additional 150 acres (61 ha) of wet prairie/meadow habitat in Michigan by the year 2000.</li> <li>4. Enhance 2000 acres (809 ha) of wildlife habitat in Michigan by the year 2000.</li> <li>5. A long-term habitat management plan for both Michigan and Ontario, including an assessment of needs (GAP Analysis) relating to wildlife diversity and integrity, will be completed to ensure continued habitat restoration and protection beyond RAP delisting.</li> </ol> | Ecosystem health (B, C)<br>Sources of contaminants (H)                                      |

### ▲ 3.3 Yardsticks

A concern echoed many times in development of the St. Clair River Remedial Action Plan is the anticipated difficulty during Stage 2 to adopt one set of numerical environmental objectives or "yardsticks" for a Binational Area of Concern involving numerous jurisdictions.

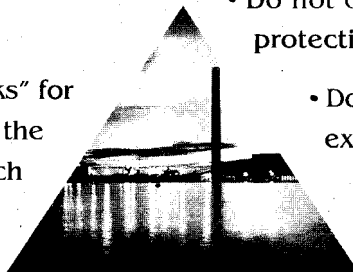
The purpose of developing these "yardsticks" is twofold. The development of agreed-upon quantitative open water "yardsticks" will assist in measuring progress towards achievement of our goals and objectives in the mid to long term. The RAP recognizes the obligations under the Great Lakes Water Quality Agreement (GLWQA) to strive for virtual elimination within a philosophy of zero discharge of persistent toxic substances. In the shorter term, "yardsticks" will assist efforts to measure potential impact from existing sources and assess the need for additional remediation.

Rationale for selecting numerical "yardsticks" for the St. Clair River RAP was the selection of the lowest, scientifically valid number from each of the five principle jurisdictions (Ontario, Michigan, Canadian and U.S. Federal Governments and IJC). Other jurisdictional numbers within the Great Lakes Basin were used in the absence of a number from any of the above five jurisdictions. These "yardsticks" are subject to revision, should new scientifically valid values be produced or new criteria be adopted by one of the relevant jurisdictions in future. The development and use of these "yardsticks" does not imply agency endorsement of any numbers, other than those published by that agency. The following tables (Table 3.2 and 3.3) were not compiled to imply support by one government department of criteria/standards/objectives or other measures developed by another agency, but are put forth as quantitative open water RAP targets to be used to measure progress in achieving RAP qualitative goals and objectives.

Water quality "yardsticks" are shown in Table 3.2, sediment and biota "yardsticks" in Table 3.3.

Conditions used in the development of the "yardsticks" are listed below.

- "Yardsticks" must be measurable by agreed-upon analytical techniques for water, sediment and biota (ranging from standard method detection levels to **non-routine ultra-trace level methods**).
- "Yardsticks" must be established with the knowledge of lower Lake Huron levels (i.e. what is coming into the St. Clair River) and at or above these levels.
- With respect to water quality "yardsticks", use only "ambient" criteria and do not consider livestock, irrigation or other uses including drinking water. In addition, only "yardsticks" which were appropriate to the hardness of the St. Clair River AOC (i.e. 100 mg/L CaCO<sub>3</sub>) would be used.
- Do not consider numbers developed for acute protection only.
- Do not consider those which are "proposed" except in the absence of other data.



### ▲ 3.4 Development of Yardsticks

A number of concurrent efforts have been initiated to address this binational issue through the IJC and Federal, Provincial and State Governments. Notably, attempts to compile and condense water quality criteria, guidelines, objectives, rules and standards, have been undertaken as part of the "Binational program to restore and protect the Lake Superior Basin" and in the "Lake Ontario Toxics Management Plan", as well as the U.S. EPA "Great Lakes Initiative".

It was generally agreed that the "yardstick" values for action within the St. Clair River AOC would be at or above lower Lake Huron levels. In this case, restoration targets within the Area of Concern would be to the lower Lake Huron level, while recommendations will be made to external sources to alleviate stresses on Lake Huron.

Environmental water quality "yardsticks" for the St. Clair River RAP.  
(see Appendix 3.1 for explanation of abbreviations and references for data/values).

| Substance              | Lower Lake Huron<br>ug/l<br>(ppb) | Detect. Limit<br>ug/l Range<br>(ppb) | "Yardstick"<br>ug/l (ppb) | Present Level<br>in River<br>max (ppb) | Protected<br>Use(s) | Agencies        |
|------------------------|-----------------------------------|--------------------------------------|---------------------------|----------------------------------------|---------------------|-----------------|
| <b>Metals</b>          |                                   |                                      |                           |                                        |                     |                 |
| Arsenic                | 0.21                              | 1.0                                  | 1.0                       |                                        | HH                  |                 |
| Cadmium                | 0.025                             | 0.5                                  | 0.5                       |                                        | AH                  | ON/IJC          |
| Chromium Vi            | 0.3                               | 5                                    | 5                         | 3.5 (1991)                             | AH                  | MI              |
| Copper                 | 0.4                               | 5                                    | 5                         | 4 (1990)                               | AH                  | CCME            |
| Iron                   | 70                                | 20                                   | 300                       | 2,433 (1989)                           | AH                  | (6)             |
| Lead                   | 0.10                              | 0.5                                  | 2.9                       |                                        | AH                  | MI              |
| Manganese              | 1.4                               | 0.5                                  | 50                        |                                        | AES                 | EPA/ON          |
| Mercury                | 0.011                             | 0.005                                | 0.011                     | 0.03 (1990)                            | AH                  |                 |
| Nickel                 | 0.61                              | 2                                    | 25                        |                                        | AH                  | IJC/ON          |
| Zinc                   | 0.56                              | 2                                    | 30                        | 14.5 (1991) Mean                       | AH/AES              | IJC/ON/<br>CCME |
| <b>Conventionals</b>   |                                   |                                      |                           |                                        |                     |                 |
| Bacteria               | 0                                 | N/A                                  | 33/100mls                 | 8017 (1990)                            | HH                  | EPA             |
| Chloride               | 610                               | 2(ppm)                               | 50000                     |                                        | ALL                 | MI              |
| Oil & Grease           |                                   | 1(ppm)                               | Narrative                 |                                        |                     |                 |
| Total Phosphorous      | 8.4                               | 20                                   | 20                        | 36 (1991)                              | AES                 | ON              |
| <b>Organics</b>        |                                   |                                      |                           |                                        |                     |                 |
| Benzene                | <0.05                             | 0.5                                  | 6.6                       |                                        | HH                  |                 |
| Carbon Tetrachloride   | <1                                | 1.3                                  | 4                         |                                        | HH                  |                 |
| Chlorophenols          |                                   | 0.1-1                                | 7                         |                                        | AH                  | ON              |
| 1,1-Dichloroethane     |                                   | 0.8                                  | 50                        |                                        | HH                  | NYS             |
| 1,2-Dichloroethane     |                                   | 0.5                                  | 9.4                       |                                        | HH                  |                 |
| Dieldrin               | 0.0003                            | 0.00005-0.02                         | 0.0003                    |                                        |                     |                 |
| Hexachlorobenzene      | <0.00004                          | 0.00004-0.01                         | 0.001                     |                                        | HH                  | EPA             |
| Hexachlorobutadiene    | <0.001                            | 0.01                                 | 0.1                       |                                        | AH                  | CCME            |
| Hexachloroethane       | .0008                             | 0.01                                 | 13                        |                                        | HH                  | MI              |
| PAHs (B(a)p)           |                                   | 0.01-0.5                             | 0.1                       |                                        | AH                  | IJC             |
| PCBs                   | <0.0008                           | 0.0008-0.2                           | 0.001                     | 0.0024(1989)Mean                       |                     |                 |
| Pentachlorobenzene     | <0.00004                          | 0.00004-0.01                         | 0.03                      |                                        | AH                  | ON/CCME         |
| Tetrachloroethylene    | <1                                | 0.5                                  | 8                         |                                        | HH                  |                 |
| 1,1,1-Trichloroethane  | <0.02                             | 0.2                                  | 120                       |                                        | AH                  | MI              |
| 1,1,2-Trichloroethane  |                                   | 0.5                                  | 6                         |                                        | HH                  |                 |
| Trichloroethylene      |                                   | 1                                    | 27                        |                                        | HH                  |                 |
| 2,4,5-Trichlorotoluene | <0.001                            | 50                                   |                           |                                        |                     |                 |
| Toluene                | <0.05                             | 0.5                                  | 110                       |                                        | AH                  | MI              |
| Xylene-m               | <0.1                              | 0.5-1                                | 2                         |                                        | AH                  | ON              |
| Xylene                 | <0.1                              |                                      | 59                        |                                        | AH                  | MI              |

AH Aquatic Health  
EPA United States Environmental Protection Agency  
MN Minnesota  
NY No Yardstick  
WI State of Wisconsin Department of Natural Resources

MI Michigan Department of Natural Resources  
AES Aesthetics  
ON Ontario Ministry of the Environment and Energy  
PA Pennsylvania  
NA Not applicable

HH Human Health  
CCME Canadian Council of Ministers of the Environment  
IJC International Joint Commission  
NYS New York

## Environmental sediment and biota "yardsticks" for the St. Clair River RRP

(see Appendix 3.1 for explanation of abbreviations and references for data/values)

| Substance              | Lower<br>L. Huron<br>Levels<br>ng/g (ppb) | Sediment<br>Yardstick<br>ng/g (ppb) | Present<br>Level in<br>River<br>max (ppb) | Protected<br>Use | Agency | Biota<br>Yardstick<br>ng/g (ppb) | Present<br>Level in<br>River<br>max (ppb) | Protected<br>Use | Agency | High<br>Cons.<br>Yardstick<br>(ppb) | Protected<br>Use | Agency |
|------------------------|-------------------------------------------|-------------------------------------|-------------------------------------------|------------------|--------|----------------------------------|-------------------------------------------|------------------|--------|-------------------------------------|------------------|--------|
| <b>Metals</b>          |                                           |                                     |                                           |                  |        |                                  |                                           |                  |        |                                     |                  |        |
| Arsenic                | 4,200                                     | 4,200                               | 9,100 (1989) Mean                         | AH               |        | 0.097                            |                                           | HH               | EPA    |                                     |                  |        |
| Cadmium                | 1,100                                     | 1,100                               | 1,400 (1990)                              | AH               |        |                                  | 690 (1991)                                |                  |        |                                     |                  |        |
| Chromium Vi            | 31,000                                    | 31,000                              | 36,800 (1989) Mean                        | AH               |        |                                  |                                           |                  |        |                                     |                  |        |
| Copper                 | 25,000                                    | 25,000                              | 140,000 (1990)                            | AH               | ON     |                                  | 1,500 (1991)                              |                  |        |                                     |                  |        |
| Iron                   | 31,200,000                                | 31,200,000                          | 26,600,000 (1991)                         | AH               | ON     |                                  |                                           |                  |        |                                     |                  |        |
| Lead                   | 23,000                                    | 31,000                              | 297,300 (1989) Mean                       | AH               | ON     | 1,000                            | 710 (1991)                                | HH               | ON     |                                     |                  |        |
| Manganese              | 400,000                                   | 400,000                             | 492,000 (1990)                            | AH               |        |                                  | 1,800 (1991)                              |                  |        |                                     |                  |        |
| Mercury                | 100                                       | 200                                 | 4,900 (1990)                              | AH               | ON     | 500                              | 1,600 (1991)                              | HH               | (7)    |                                     |                  |        |
| Nickel                 | 31,000                                    | 31,000                              | 55,000 (1990)                             | AH               |        |                                  | 840 (1991)                                |                  |        |                                     |                  |        |
| Zinc                   | 65,000                                    | 90,000                              | 250,000 (1990)                            | AH               | EPA    |                                  | 35,000 (1991)                             |                  |        |                                     |                  |        |
| <b>Conventionals</b>   |                                           |                                     |                                           |                  |        |                                  |                                           |                  |        |                                     |                  |        |
| Bacteria               |                                           |                                     |                                           |                  |        |                                  |                                           |                  |        |                                     |                  |        |
| Chloride               |                                           |                                     |                                           |                  |        |                                  |                                           |                  |        |                                     |                  |        |
| Oil & Grease           |                                           | 1,000                               | 1,772 (1990)                              | AH               | EPA    |                                  |                                           |                  |        |                                     |                  |        |
| TKN                    |                                           | 550                                 | 1,970 (1989) Mean                         | AH               | ON     |                                  |                                           |                  |        |                                     |                  |        |
| Total Phosphorous      |                                           | 420                                 | 720 (1989)                                | AH               | EPA    |                                  |                                           |                  |        |                                     |                  |        |
| <b>Organics</b>        |                                           |                                     |                                           |                  |        |                                  |                                           |                  |        |                                     |                  |        |
| Benzene                |                                           |                                     |                                           |                  |        |                                  |                                           |                  |        |                                     |                  |        |
| Carbon Tetrachloride   |                                           |                                     |                                           |                  |        |                                  |                                           |                  |        |                                     |                  |        |
| Chlorophenols          |                                           |                                     |                                           |                  |        |                                  |                                           |                  |        |                                     |                  |        |
| 1,1-Dichloroethane     |                                           |                                     |                                           |                  |        |                                  |                                           |                  |        |                                     |                  |        |
| 1,2-Dichloroethane     |                                           |                                     |                                           |                  |        |                                  |                                           |                  |        |                                     |                  |        |
| Dieldrin               | I                                         | I                                   |                                           | AH               |        | 0.37                             |                                           | HH               | EPA    | 0.02                                | HH               | NA     |
| Hexachlorobenzene      | I                                         | 10                                  | 289,300 (1990)                            | AH               | ON     | 100                              | 88 (1991)                                 | HH               | HWC    | 4                                   | HH               | NA     |
| Hexachlorobutadiene    |                                           |                                     | 488,000 (1990)                            |                  |        | 1,300                            | 35 (1991)                                 | AH               | NY     |                                     |                  |        |
| Hexachloroethane       |                                           |                                     | 1,900 (1990)                              |                  |        |                                  | 2 (1991)                                  |                  |        |                                     |                  |        |
| Octachlorostyrene      |                                           |                                     |                                           |                  |        | 20                               | 540 (1991)                                | AH               | NY     |                                     |                  |        |
| PAHs                   |                                           | 2,000                               | 54,300 (1990)                             | AH               | ON     | 0.93                             |                                           | HH               | EPA    | 0.04                                | HH               | NA     |
| PCBs                   | 20                                        | 20                                  | 2,020 (1990)                              | AH               |        | 2.5                              | 2,450 (1991)                              | HH               | EPA    | 0.1                                 | HH               | NA     |
| Pentachlorobenzene     |                                           |                                     | 1,600 (1990)                              |                  |        |                                  | 3 (1991)                                  |                  |        |                                     |                  |        |
| Tetrachloroethylene    |                                           |                                     |                                           |                  |        |                                  |                                           |                  |        |                                     |                  |        |
| 1,1,1-Trichloroethane  |                                           |                                     |                                           |                  |        |                                  |                                           |                  |        |                                     |                  |        |
| 1,1,2-Trichloroethane  |                                           |                                     |                                           |                  |        |                                  |                                           |                  |        |                                     |                  |        |
| Trichloroethylene      |                                           |                                     |                                           |                  |        |                                  |                                           |                  |        |                                     |                  |        |
| 2,4,5-Trichlorotoluene |                                           |                                     | 121,000 (1990)                            |                  |        |                                  |                                           |                  |        |                                     |                  |        |
| Toluene                |                                           |                                     |                                           |                  |        |                                  |                                           |                  |        |                                     |                  |        |
| Xylene                 |                                           |                                     |                                           |                  |        |                                  |                                           |                  |        |                                     |                  |        |

AH Aquatic Health  
 EPA United States Environmental Protection Agency  
 MN Minnesota  
 NY No Yardstick  
 WI State of Wisconsin Department of Natural Resources

MI Michigan Department of Natural Resources  
 AES Aesthetics  
 ON Ontario Ministry of the Environment and Energy  
 PA Pennsylvania  
 NA Not applicable

HH Human Health  
 CCME Canadian Council of Ministers of the Environment  
 IJC International Joint Commission  
 NYS New York

Parameters for which desirable "Yardstick" levels are below (shaded) documented lower Lake Huron levels or standard analytical Method Detection Limit (MDL).

|                   | Water                              |                                 |                          | Sediment                               |                                     |
|-------------------|------------------------------------|---------------------------------|--------------------------|----------------------------------------|-------------------------------------|
|                   | Lower Lake Huron Level (Water-ppb) | Desired "Yardstick" (Water-ppb) | Standard MDL Range (ppb) | Lower Lake Huron Level (Sediments-ppb) | Desired "Yardstick" (Sediments-ppb) |
| Arsenic           | 0.21                               | 0.2                             | 1.0                      | 4,200                                  | 3,000                               |
| Cadmium           | 0.025                              | 0.2                             | 0.5                      | 1,100                                  | 600                                 |
| Chromium          | 0.3                                | 1.7                             | 5                        | 31,000                                 | 26,000                              |
| Copper            | 0.4                                | 2                               | 5                        | 25,000                                 | 16,000                              |
| Dieldrin          | 0.0003                             | 0.000032                        | 0.00005-0.02             | 1                                      | 0.6                                 |
| Hexachlorobenzene | <0.00004                           | 0.0001                          | 0.00004-0.01             | 1                                      | 10                                  |
| Manganese         | 1.4                                | 50                              | 0.5                      | 400,000                                | 300,000                             |
| Mercury           | 0.011                              | 0.0013                          | 0.005                    | 100                                    | 200                                 |
| Nickel            | 0.61                               | 25                              | 2                        | 31,000                                 | 16,000                              |
| Total Phosphorous | 8.4                                | 10                              | 20                       |                                        | 420                                 |
| PCBs              | <0.0008                            | 0.001                           | 0.0008-0.2               | 20                                     | 10                                  |

Specific parameters for which the lower Lake Huron levels have been adopted as a "yardstick" include arsenic and dieldrin, in water and sediments, mercury in water, as well as cadmium, chromium, manganese, nickel and PCBs in sediments. For these parameters, the "yardstick" value below the lower Lake Huron level and the standard method detection limit are presented in Table 3.4.

The St. Clair River RAP Subcommittee with expert advice, opted to utilize conservative values including new information on bioconcentration factors and cancer potency estimates. A  $10^{-5}$  (1 in 100,000 cancer risk) risk value was selected from the incremental risk values put forth by EPA in their determination. This  $10^{-5}$  risk value is consistent with both Health & Welfare Canada's risk assessment practices, as well as that which is proposed under the recent EPA Great Lakes Initiative. In a number of instances following incorporation of new information, aquatic and human health based standards were remarkably similar and the lowest value was retained.

Some beneficial use impairments have direct human health implications while others are indicators of potential human health impairments. Although a considerable amount of information has been

collected on levels of contaminants in the environment, still more is needed to assess human health implications. Simple potential risk indicators like the distance of landfill sites to human areas and more complex issues such as who is eating wildlife and in what quantities, need to be addressed. Moreover, data needs to be current to be relevant to exposure assessment. Remediating human exposure to contaminants includes not only source control but also personal exposure reduction education.

There are six main exposure pathways through which contaminants in the environment come into contact with humans. These pathways include water, air, food, soil, sediments and consumer products. Contaminants can enter the body internally through ingestion and inhalation and externally through direct contact with skin.

The St. Clair River RAP is aware of the connections between human health and the environment. Many of the remedial activities underway or proposed will make the AOC a healthier place to live by reducing levels of contaminants in the water, sediment, air and food.

With respect to sediment quality criteria and fish contaminant criteria, typically only one standard



existed for each individual parameter. In instances where more than one standard existed per parameter, the most stringent number was selected to be the desired "yardstick". Some discrepancies have been noted between data and interpretation for each jurisdiction's fish contaminant criteria. It was determined that where data for a particular jurisdiction is based upon fish fillets, direct comparison with the "yardstick" for all parameters could be undertaken.

Sediment "yardstick" values which have been selected from the OMOEE biologically based Provincial Sediment Quality Guidelines, are to be used as a trigger for action and serve to initiate activities necessary to document the degree and extent of sediment contamination.

These "yardsticks" have been developed for a short list of "contaminants of concern" as determined as part of Stage 1; however, it is incumbent on the RAP Implementation Committee, and BPAC to continually review data against available standards to ensure that potential or emerging contaminants of concern (including the recently released COA Tier 1 and Tier 2 substances) and revised objectives/guidelines/ standards have not been overlooked. Further, implications to the yardsticks and subsequent remediation requirements relating

to future improvements in water quality within the AOC and Lake Huron will require continual assessment as new data are collected and data gaps filled.

Of particular importance to the St. Clair River Area of Concern is the lack of guidelines/objectives designed to protect individuals consuming greater than "average" amounts of fish and game. The RAP will seek to have appropriate jurisdictions develop applicable guidelines/objectives for these "high consumers" to afford an acceptable level of protection.

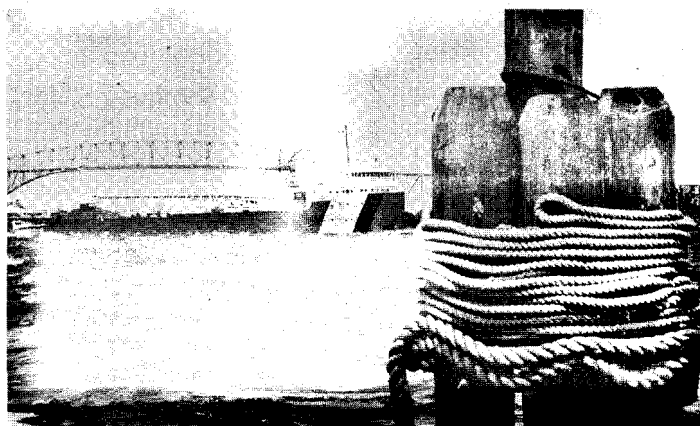
### ■ 3.5 Remedial Action Development

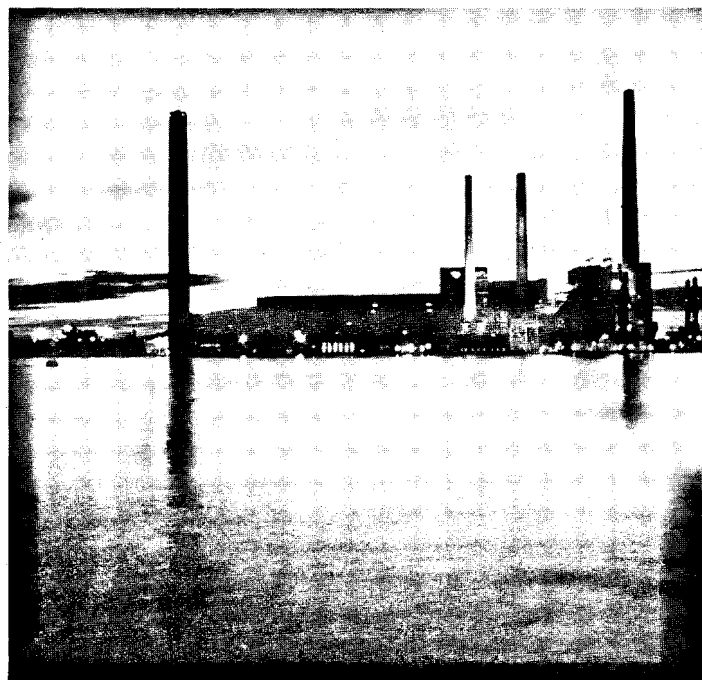
The Stage 2 process for the three Ontario - Michigan international Remedial Action Plans (St. Clair, St. Marys

and Detroit rivers AOCs) involved the use of a task oriented focus. As part of this process, the St. Clair River RAP Team and BPAC established four "Task Teams" to undertake the assessment and evaluation of remedial options. Each Task Team consisted of BPAC and RAP Team members and others having interests and expertise relating to the task. Agency representatives

on each Task Team provided technical input and support as required. The four Task Teams and number of working meetings were as follows:

- Point Source Task Team (13)
- Non-Point Source Task Team (8)

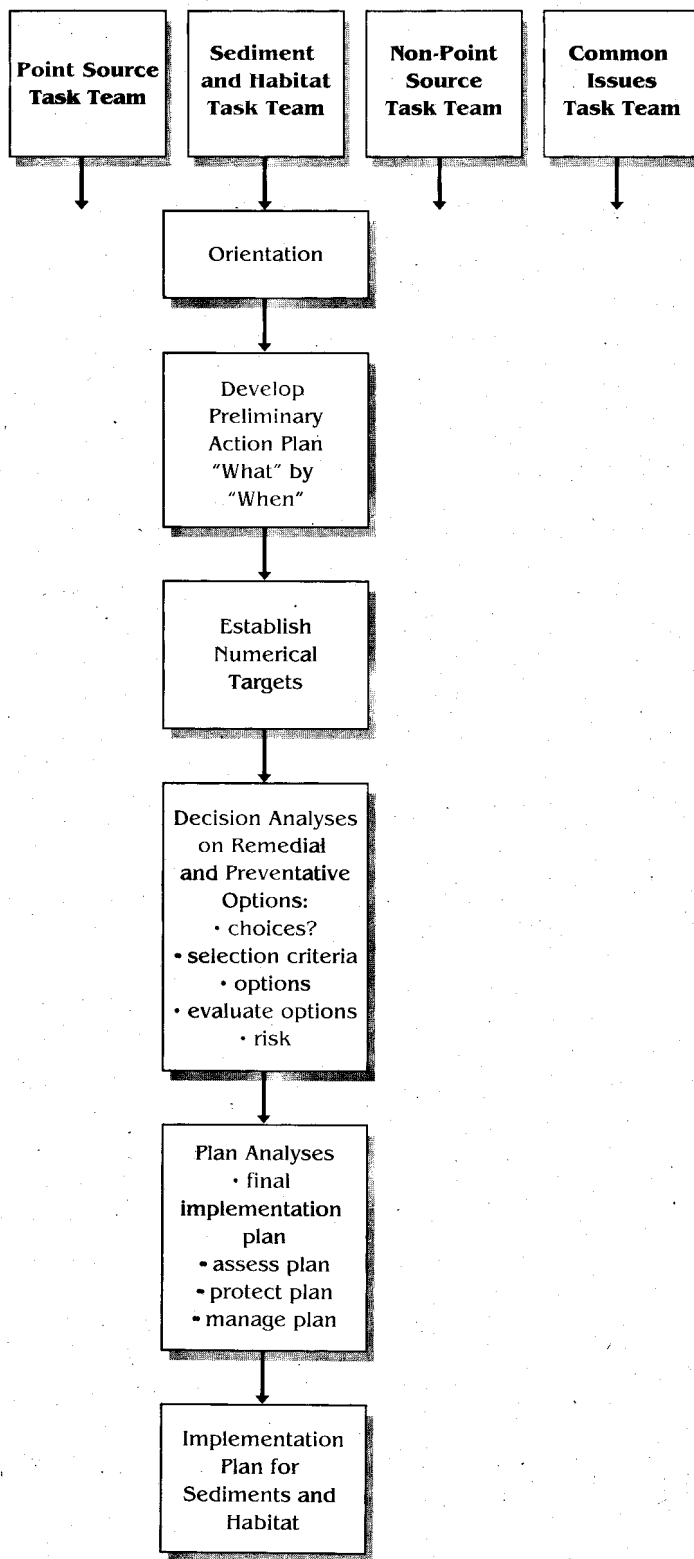




- Sediment and Habitat Task Team (12)  
(Sediment Subcommittee - 6)
- Common Issues Task Team (5)  
(Education Subcommittee - 3)

Figure 3.1 illustrates the Task Team process employed to address remedial options and preferred actions. The Task Teams began their deliberations in February 1993 following release of the goals and objectives and concluded their activity with the release of this Stage 2 document. Each of the four teams developed an "Action Plan" which was used to define the steps or processes required for the identification of remedial options and selected recommended actions. Each Action Plan identified key milestones, individuals/groups/agencies responsible for completion of each task, and a timetable for completion. The Sediments and Habitat Task Team developed separate Action Plans for sediment and habitat. The five Action Plans are provided in full in Appendix 3.2 and each is briefly summarized at the beginning of subsequent chapters which detail the results of the Task Team deliberations (Chapters 4 through 8).

## Process for Assessment and Evaluation of Remedial Options for Point-Source, Non-Point Source, Habitat and Sediment, and Common Issues Task Teams.



**T**he Point Source Task Team formally defined 'Point Source' as follows:

Any discrete, quantifiable discharge (air and/or water), e.g., outfall, pipe, conduit, lined ditch/channel, tunnel, which discharges directly to the St. Clair River or its tributaries from industrial/municipal discharges including:

- storm water runoff from developed areas of industrial sites/activities;
- urban storm runoff;
- spills;
- CSOs;
- residential discharges;
- landfill leachate systems.

The Point Source Work Plan was developed to respond to the Water Use Goals and Objectives outlined in Section 3.1. This work plan represents actions undertaken by the Point Source Task Team for the development of the Stage 2 RAP. The complete Work Plan is provided in

Appendix 3.2. Work carried out by the Point Source Task Team is summarized below and does not represent recommended actions resulting from task team deliberations. Recommendations (actions) are summarized at the end of this chapter. Work Plan components include:

- Prepare a prioritized list of point sources based on impairment of beneficial use;
- Develop a list of performance goals, action and a time-line for commitment and implementation;
- Identify environmental "yardsticks" or standards for water quality, sediment and biota;
- Run models under various scenarios (Section 4.3.3);
- Identify and prioritize gaps between projected water quality and yardstick/impairments;
- Rank each gap and identify point sources;

- Define and recommend performance levels required to remove point source from high rank list; and
- Negotiate additional performance commitments.

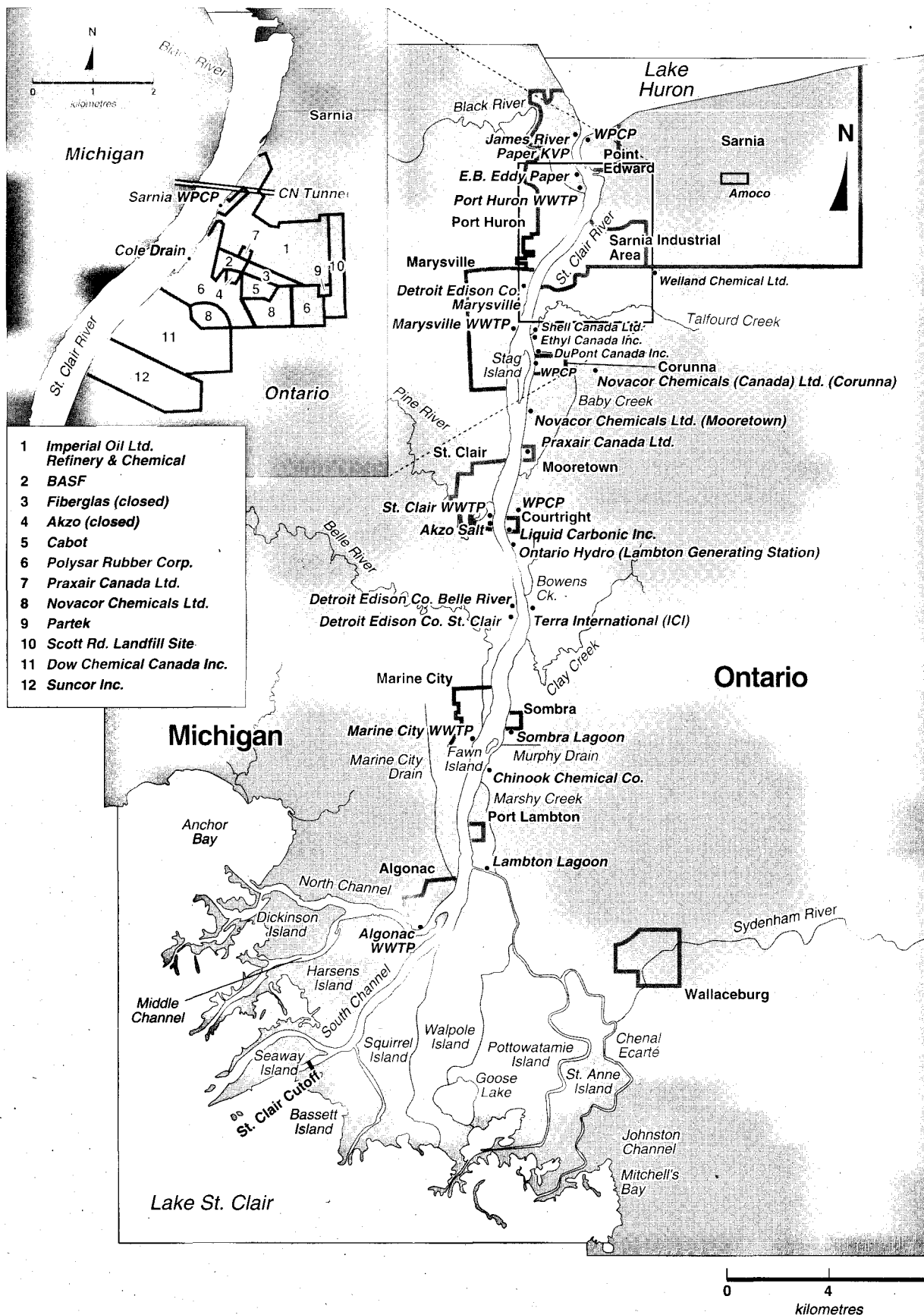
Based on available data, industrial and municipal point sources have been found to contribute the largest loadings of most identified contaminants within the St. Clair River AOC. From a remediation strategy, these sources thus offer an opportunity to achieve significant reductions in total loadings for a number of parameters. Indeed, since the first river contaminant surveys were conducted during the mid 1960's, significant reductions in numerous chemicals have already occurred. The locations of point source dischargers to the St. Clair River are shown in Figure 4.1.

Eight of the nine beneficial use impairments are directly related to contaminants which, based on data available at the time, are or were contributed to the AOC primarily from industrial or municipal point sources (including CSOs). The impairment and associated chemicals are as follows:

- restrictions on fish consumption (mercury, PCB's, dioxins and furans);
- chironomid mouth part anomalies (related to water and/or sediment contamination);
- degradation of benthos (through sediments contaminated with copper, mercury, nickel, zinc, oil and grease, total organic carbon, total phosphorus, benzene, ethylbenzene, styrene, total PAHs and HCB);
- restrictions on dredging (copper, cadmium, chromium, lead, mercury, zinc, oil and grease, HCB, total PAHs);
- drinking water supply (chemical spills);
- degradation of aesthetics (scums, spills, oil and grease);
- cost to agriculture or industry (spills, contaminated sediments); and
- beach closings (bacteria).



# Location of Major Point Source Dischargers to the St. Clair River



In addition to these use impairments, ambient water, sediment and biota quality guideline exceedences have been reported for chemicals or metals associated with current and/or historical point source discharges.

Early in the Stage 2 process, the RAP Team commissioned a study to evaluate technical options for remediation of use impairments. This report (Beak 1993) outlined detailed, site-specific technical options and approximate costs for addressing source controls as well as sediment and habitat remediation. The Beak (1993) report has been reproduced in its entirety as Appendix 4.3 to this Stage 2 document. Following extensive discussions with BPAC and RAP Team members, it was agreed that with respect to point sources, a more effective approach would be to identify performance expectations or a "yardstick" necessary to achieve RAP goals and objectives and to rely on individual sources to comply. This was felt to be the approach most likely to succeed given the complex technical, economic and social issues at hand for each facility. The RAP Implementation Committee will pursue the achievement of these "yardsticks" through ongoing monitoring and iterative discussions with both municipal and industrial dischargers.

## ▲ 4.1 Regulatory Programs

Regulatory programs and policies applicable to industrial and municipal discharges are provided in detail in Appendix 4.1. These regulations and policies are summarized below.

### ▲ 4.1.1 Ontario and Canada

The *Ontario Water Resources Act* (OWRA) and the *Environmental Protection Act* (EPA) are directly applicable to industrial and municipal direct dischargers. Generic effluent objectives have been developed for several parameters and Policy 3 of the OMOEE Water Management Goals, Policies, Objectives and Implementation Procedures dictates

that effluent limits will be established based on the waste receiving capacity of a water body and the Provincial Water Quality Objectives. Part 10 of the EPA, referred to as the "Spills Bill", establishes notification requirements, responsibilities (for notification, response, and liabilities), compensation mechanisms, and offenses for prosecution.

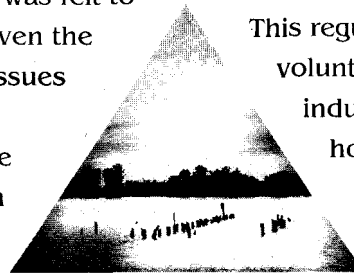
Ontario has established a regulatory based program to control toxic contaminants in municipal and industrial effluents. The Municipal-Industrial Strategy for Abatement (MISA) Program, allows the Province to enforce technology-based effluent limits with minimum pollution control requirements related to the implementation of Best Available Technology Economically Achievable (BATEA).

The MISA Municipal Sector has recently proposed a sewer use regulation and model sewer use by-law.

This regulation would be complimented by voluntary pollution prevention initiatives by industry and public education initiatives with householders to significantly reduce the discharge of toxic substances to municipal sewers. Details of this regulation are provided in Appendix 4.1.

Air quality in Ontario is regulated under Regulation 346 of the *Environmental Protection Act*. Under this regulation, OMOEE may prepare an "Air Pollution Index" to express relative levels of air pollution. As an index level is approached or exceeded, the OMOEE, in consultation with the Ministry of Health, may order curtailment of the operation of sources of air pollution. The Regulation also identifies the maximum contaminant concentration at a point of impingement from a source.

The *Fisheries Act* and *Canadian Environmental Protection Act* (CEPA) are the most significant federal legislation pertaining to point source regulations. The habitat protection provisions of the *Fisheries Act* provide comprehensive powers to protect fish, fish habitat and human use of fish by prohibiting the discharge of deleterious substances causing an



impact on fish or fish habitat. Under this act, federal effluent regulations affecting this AOC have been promulgated for the petroleum refining and metal finishing sectors. The federal Petroleum Refinery Liquid Effluent Regulations apply to one facility within the St. Clair River watershed. These regulations limit (based on production rates) discharges of oil and grease, phenols, sulphide, ammonia-nitrogen, and total suspended matter as well as controlling acute toxicity and pH. Although the regulations do not technically apply to the other three petroleum refineries (because they existed prior to the regulation coming into force), they are subject to guidelines which are based on the federal regulations. The *Canadian Environmental Protection Act* identifies specific chemicals subject to regulation. CEPA can be used to regulate any toxic substance which is released into the air and which creates, or may reasonably be anticipated to create, air pollution in any other country. Regulations are currently in place for vinyl chloride from polyvinyl chloride plants within the AOC.

#### ■ 4.1.2 Michigan and United States

Effluent requirements for wastewater discharged to Michigan surface waters are established in National Pollutant Discharge Elimination System (NPDES) permits. NPDES permits are required for all municipal and industrial point source discharges and are issued under the U.S. *Clean Water Act* and the *Michigan Water Resources Commission Act*. Effluent limits are required to be as stringent as the national effluent guidelines.

In November 1990, based on 1987 amendments to the *Clean Water Act*, the U.S. EPA passed new regulations requiring certain commercial and industrial facilities to apply for NPDES permits for storm water discharges from point sources. Municipalities with populations over 100,000 and served by separate storm sewers were also required to apply for an NPDES permit.

Several state and federal regulations are all used to address spill prevention and response. The *Michigan*

*Water Resources Act* has been the most significant regulation used to reduce the impact, number and severity of spills. This act regulates storage and shipping for all "polluting materials" and acts as a mechanism for the establishment of spill prevention, notification and clean-up procedures.

Non-domestic users which discharge to municipal WWTPs, come under the Industrial Pretreatment Program (IPP) of the NPDES permitting program. The IPP contains details as to how the industrial wastewater will be treated prior to discharge to the municipal collection system, establishes local limits, and outlines monitoring, compliance and enforcement requirements.

Air pollution control is addressed through a permitting process similar to the NPDES process, under the authority of the federal *Clean Air Act* and the *Michigan Air Pollution Act*. The *Clean Air Act* also includes specific provisions for the protection of the Great Lakes from toxic air pollutants.



#### ■ 4.2 Actions in Progress Related to Use Impairments

##### ■ 4.2.1 Remediation and Prevention Approaches

In general, measures available for any point source may involve one or more of the following five major categories:

- (1) change in process resulting in an elimination or reduction in the use of or production of chemicals of concern;
- (2) change in process to closed system whereby no discharge to ambient environment occurs;
- (3) elimination of process entirely;
- (4) improved and/or optimized water collection and treatment technology; and/or
- (5) institution of best management practices relating to storage, handling, containment, training, and so on.

Given the wide range of industrial and municipal sources, including stormwater and CSOs, and the large number of facilities discharging to the St. Clair River AOC, it is not possible in the context of this document to review all remediation approaches available. Many of these have been described in the Beak (1993, Part B - Appendix 4.3) report on industrial and municipal sources. Rather than recommend specific technologies for each point source in the AOC, the Task Team has focused on the determination of required loadings to meet yardsticks (KETOX model, Section 4.3.3) and a quantitative ranking of individual sources of specific contaminants. Required reductions at each facility will be evaluated by responsible agencies against their planned and ongoing remedial programs and, if further reductions are required to meet ambient yardstick values, then these will be negotiated by responsible agencies with each facility affected.

Ontario industrial and municipal facilities have provided current and projected contaminant loadings to the St. Clair River for modelling. These projections are presented in Appendix 4.2 and all facilities are striving to meet these projections by the year 2000.

## 4.2.2 Ongoing Programs

### Ontario Municipal

**Corunna WPCP:** This WPCP is operated by the Ontario Clean Water Agency and is an extended aeration secondary treatment facility with continuous phosphorus removal and chlorination. There have not been any upgrades since 1990 and none are anticipated. The option identified for this plant is optimization to improve the removal efficiency of pollutants.

**Courtright WPCP:** This WPCP is also operated by the Ontario Clean Water Agency. It is an extended aeration secondary treatment facility with continuous phosphorus removal and chlorination.

It underwent a major study in 1992 and 1993 to optimize plant performance. Improvements have been realized as a result of this study. No additional improvements are planned.

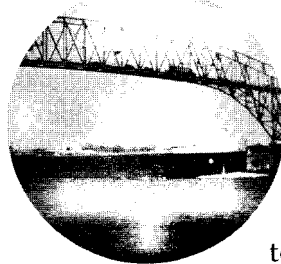
### Point Edward Water Pollution Control Plant (WPCP):

This plant is operated by the municipality. It was upgraded to secondary treatment and ultraviolet disinfection in October 1992. This has resulted in major improvements to effluent quality. The only technical option identified for this plant is process optimization to ensure maximum efficiency. Optimization of the new secondary treatment facility is presently being undertaken.

**Sarnia WPCP:** The Sarnia WPCP is operated by the municipality. It is currently a primary treatment facility with continuous phosphorus removal and seasonal effluent chlorination. The City of

Sarnia has retained a consultant for an Environmental Study Report and Design for upgrading the plant to secondary treatment. This upgrade has a projected cost of \$33 million and is expected to result in loading reductions of 50% for total suspended solids, 70% for BOD, 100% for fecal coliforms and 0% for total phosphorus. The secondary treatment upgrade is expected to be completed and operating by 1997. This upgrade is part of the recommendations identified in a Pollution Control Plan which was completed for the municipality in March 1993 by UMA Engineering Ltd. The preparation of the Pollution Control Plan was cost shared by the municipality, OMOEE and Environment Canada's Great Lakes Cleanup Fund. Funding for the Pollution Control Plan was prompted in large part because Sarnia is situated within the St. Clair River AOC.

The proposed upgrade design for the Sarnia WPCP will also increase plant capacity and significantly reduce combined sewer overflows while providing primary treatment and disinfection (likely ultraviolet method) to any which occur. The



Pollution Control Plan has been formally adopted as City Policy and includes the installation of CSO storage tanks and a treatment pond system for the storm sewers that are contaminated with CSOs. The total cost of CSO controls is projected at \$11.7 million. Installation of off-line storage tanks has begun and completion dates are as follows: Devine St. (the largest) will be 85% complete by March 1996 and cost approximately \$4.7 million. CSO from Wellington St. will be conveyed to an enlarged storage tank at Devine St.; Cromwell St. - 1997 (\$4.5 million); Exmouth St. - 1999 (\$2.5 million); and the retention pond system will be completed in 2003 (\$6.7 million). Upon completion of the CSO project, only 3 to 5 CSO events per year are expected however, these CSO events will be disinfected before discharge using the ultraviolet method. The CSO control project is being funded by the federal/provincial infrastructure program.

The City of Sarnia instituted a program over the past several years to install water meters in homes which were previously not metered. This action, in addition to an environmental surtax based on water consumption, has had the effect of lowering water consumption and establishing a fund to defray infrastructure costs.

There are no ongoing or planned upgrades/studies for either the Sombra or Port Lambton Lagoons. The use of physical-chemical treatment and an aerated and/or facultative lagoon and a multi-cell intermittent sand filter has been suggested for upgrading these lagoons.

#### **Ontario Industrial**

**AKZO Chemicals Ltd. (Sarnia):** This facility has been shut down since 1992 and decommissioning programs are nearing completion. Decommissioning programs include: removal of equipment; removal and appropriate disposal of wastes such as organic amines, ammonia, methyl chloride and hydrogenated tallow fatty acids; removal and remediation of

historic ethyl benzene contaminated soil; and soil and groundwater surveys.

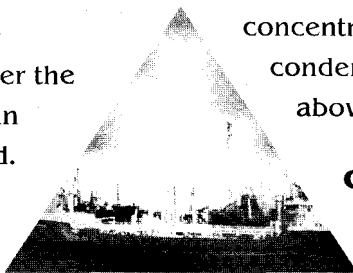
**AMOCO Canada Resources Ltd. (Sarnia):** A waste audit study was undertaken in 1993 to identify contaminant sources for evaluating various treatment options available. A leak abatement program is also underway to minimize contamination of surface runoff by leaking process stream valves.

**BASF Canada Inc. (Sarnia):** Recently completed and ongoing remedial measures at this facility include: new primary treatment facility for removal of rubber from process effluent; further treatment of effluent at Polysar's biological treatment plant; water conservation programs have reduced consumption by about 50% since 1990 and further reductions are planned; process related improvements to non-contact cooling water to reduce acrylonitrile concentrations; installation of new vertical condenser (1992) to pressurize cooling water above that of process water.

**Cabot Canada Ltd. (Sarnia):** Cabot has examined using treated effluent in the process to achieve zero discharge, however, this was determined not to be feasible. The company may re-evaluate this option.

**Chinook Chemicals Company (Sombra):** Process and storm sewer effluents are treated for odour (peroxide treatment) in a holding pond then spray irrigated during summer and discharged to the river during winter. Recently completed and ongoing remedial measures at Chinook Chemicals include: improved aeration of collected rainfall water holding pond; toxicity source investigation/evaluation; ultraviolet/ ozone treatment for organics removal; groundwater and soil surveys; revision of the dimethylformamide process to reduce contaminants in final discharge; implementation of new methylamine production technology.

**Cole Drain (Cut-Off Drain):** Although not an industrial facility, this drain contributes significant



loadings of contaminants from both point sources (industrial site runoff and landfill leachate) and non-point sources (urban and rural runoff). The Cole Drain is an open ditch system servicing an area south of Sarnia's residential and business core. It also receives inputs from the Scott Road Ditch prior to entering the St. Clair River.

Four waste disposal sites located on Scott Road include the Fiberglas and Dow waste sites and Polysar and Imperial Oil landfills. The Fiberglas and Dow sites are closed. Leachate from both sites pass through activated carbon beds however only leachate from Fiberglas is treated off site. Leachate from Dow is released to the Cole Drain. The Imperial Oil and Polysar landfills on Scott Road are still in operation. Both have berms to contain surface runoff and only the Imperial Oil Landfill has leachate collection and off site treatment. Both sites however, have runoff and leachate entering the Cole Drain. Polysar is currently developing a long range strategy and remedial action plan for the site.

**Dow Chemical Canada Inc. (Sarnia):** All chlorine chemistry operations at Dow Chemical in Sarnia have been shut down since mid 1993. As a result, the plant no longer produces chlorine, sodium hydroxide, ethylene dichloride, vinyl chloride, propylene oxide, nor styrene/butadiene latex. Dow is currently implementing a multi-million dollar River Separation Project which will ultimately remove the plant from direct contact with the St. Clair River - key components include: separation of non-contact cooling water from storm water collected inside the battery limits of each processing unit (to allow process unit drainage to be captured and tested before release); piping of non-contact cooling water to combined sewer collecting storm water outside of process area; assessment of spill risk from water cooled heat exchanger; reduction of process wastewater by recycling and reuse.



Dow Chemical formerly operated a waste disposal site (Scott Road) with a leachate collection system. Leachate is passed through carbon filters prior to discharge. The adequacy of the existing collection system has not been proven and there is a potential for some leachate to pass through the existing sheet pile wall and discharge to the river via the Cole Drain. Surveys are currently underway to determine the extent of hydrocarbon contamination at this waste site.

Dow Chemical operates a non-hazardous waste site on LaSalle Road. Stormwater runoff is collected in a pond where it is tested for contamination. If treatment is not required, stormwater is released to Talfourd Creek. If treatment is required, stormwater is sent to Dow's biox treatment plant.

**DuPont Canada Ltd. (Corunna):** Recently completed and ongoing remedial measures at this facility include: internal water recycling; high frequency testing and on-line analyzers for detection of leaks; studies to determine sources of dioxin and suspended solids; in-place spill response plan; dyking of all hydrocarbon storage areas; staff training.

**Ethyl Canada Inc. (Corunna):** As of May, 1993 the ethyl chloride production unit shut down and as of April 1994, all tetraethyl lead and tetramethyl lead production was halted. Continuing production at the plant consists only of mixing, blending and repackaging of industrial chemicals and the Diesel ignition improvers (DII) manufacturing. The rail tankcar/refinery cleaning and sludge recycling operations will also continue. As a result of these production shut downs, major sources of lead, ethylene dibromide, ethylene dichloride, and ethyl chloride will be removed from wastewater discharges. The DII wastewater stream will continue and the rail tankcar/refinery washings as well as out-of-spec stormwater will continue to be treated by the wastewater treatment plant to ensure the plant meets its outfall criteria.

**Fiberglas Canada Inc. (Sarnia):** This facility ceased production in 1992. Decommissioning procedures included: removal and off site disposal of contaminated stormwater and stored process water; removal and cleaning of process equipment, tanks and pipes; construction of new PCB waste storage site and proper storage of all PCB capacitors; removal of wastewater settling lagoon and surrounding contaminated soil; and demolishing of maintenance garage, #4 warehouse, waste water treatment building, furnace hall and batch silos. Where possible all metals, steel, wood and concrete have been recycled.

Fiberglas formerly operated a waste disposal site on Scott Road. The site was closed and capped in 1983. Leachate is collected, passed through activated carbon beds and treated off site.

**ICI Canada Inc. (Courtright):** ICI operates a stormwater collection system, which can be discharged through its outfall. A covered gypsum stack pondwater treatment system is also operated by ICI.

**Imperial Oil Chemicals Division (Sarnia):** Recently completed and ongoing remediation measures at this facility include: recycling of river water through three operating unit cooling systems; increased reliability of the wastewater treatment plant; improvements to wastewater treatment plant early detection systems; spill contingency plan including response team, containment measures and investigations; staff training; provision of training manuals and formal program.

**Imperial Oil Limited (Sarnia) Refinery:** Recently completed and ongoing remediation activities at this facility include: increasing steam condensate collection; reduction of cooling water usage; segregation of once-through cooling water from process streams; change to organic chemicals from metals to reduce toxicity of cooling water tower blowdown; on-line analyzers installed on once-

through cooling water discharges; dechlorination of cooling water; reduction of contaminants from activated sludge plant; staff training; and development of a spill reduction strategy including a spill source control program and on-site spill response team.

**Lambton Thermal Generating Station (Courtright):** Recently completed and ongoing remediation measures at this facility include: retrofitting of flue gas desulphurization technology designed to minimize water use and to produce a marketable by-product; dyking of storage tanks; improvement of coal and ash drainage area; construction of oil/water separators in new buildings; staff training; emergency response team trained in spill response; and a spill response plan. Other measures include a spill risk assessment, plans for installation of outfall channel booms and oil detection equipment, and studies of on-site wetlands.



**Liquid Carbonic Inc. (Courtright):** Recent initiatives undertaken at this facility include: installation of a berm at the outfall; 40% reduction in water use since 1989; installation of high/low alarms on the oil recovery drum.

**Novacor Chemicals (Canada) Ltd. (Corunna):** Recently completed and ongoing remediation activities include: reduction of cooling tower blow down; water conservation studies; elimination of metals as cooling water treatment chemicals; removal of zinc contaminated sludges and installation of easy-to-clean membranes in ponds; improved pilot plant performance (filtration and BIOX); sewer segregation; baseline benthic studies; staff training; wastewater plant operating targets and dedicated laboratory; spill response equipment.

**Novacor Chemicals (Canada) Ltd. (Mooretown):** Recently completed and ongoing remedial measures at Novacor Chemical's Mooretown facility include: installation of a geomembrane of

fibre webbing and gravel in the process wastewater pond and retention ponds; regular testing of sumps within process units prior to entering wastewater treatment system - if too highly contaminated, it is removed and disposed by a private contractor; computer program to systemize the maintenance program and equipment; spill control measures; staff training and procedural documentation. The facility is currently undertaking a total survey of its waste water streams and systems by an outside consultant. Recommendations for improvement to the waste water management system are expected.

**Novacor Chemicals (Canada) Ltd. (Sarnia):**

Recently completed and ongoing remedial measures at Novacor Chemical's Styrene II facility include: conversion of closed Styrene I ditch to use as a storm or spill retention system; evaluation of treatment technology relating to oil removal, filtration and carbon adsorption; new process technology which significantly reduces/eliminates process wastewater; spill prevention strategy.

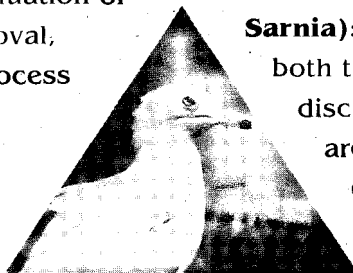
**Partek Insulations Ltd. (Sarnia):**

The non-contact cooling water effluent is scheduled to be eliminated with the installation of a cooling tower and complete recycling of cooling water. This will virtually eliminate emissions from Partek.

**Polysar Rubber Corporation (Sarnia):** Recently completed and ongoing remedial measures at this facility include: spill prevention strategy; installation of a closed-loop cooling system on one major unit in 1993 with a second unit in 1994, to eliminate possible discharges of contaminated cooling water to the river; containment and testing of storm water and fire water; re-routing of two effluent streams through the BIOX plant; installation of dechlorination facilities; partial replacement of benzene with cyclohexane; staff training; equalization basin to stabilize flows to BIOX plant

being considered; engineering studies relating to optimization of the BIOX plant, sludge dewatering and unit containment.

Polysar also operates a landfill and flyash lagoon (Scott Road) with a surface water collection system. The collected surface water is pumped via pipeline to the Polysar BIOX Plant where it is treated prior to discharge to the river. Leachate springs have been observed on the east berm and the containment of surface runoff on the eastern portion of the landfill may be inadequate. Contaminants within the Polysar perimeter drain as well as any which may reach the Scott Road Drain will eventually discharge to the St. Clair River via the Cole Drain. Polysar is currently developing a long range strategy and remedial action plan for the site.



**Praxair Canada Inc. (Moore Township and**

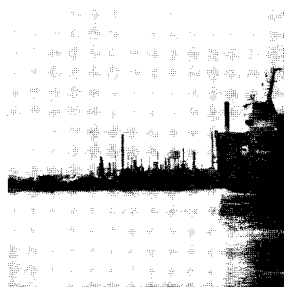
**Sarnia):** The following practices are in-place at both these facilities to reduce opportunity for discharge of toxic compounds: floor drains are covered; spill response plans; chemical storage areas are dyked; and residual chlorine and bromine have been reduced in the cooling water.

The Sarnia plant also has oil/water separators on all floor drains. In addition, a study has been undertaken to determine feasibility of substituting chlorine and bromine with ozone for cooling water treatment.

**Shell Canada Products Ltd. (Sarnia):** Recently completed and ongoing remedial measures at this facility include: installation of a third clarifier for improved TSS removal; installation of an oil/water separator to treat cooling water having potential of contamination; sewer separation program; water use reduction programs; process control of the BIOX unit; on-line leak detection; elimination of zinc and chromate from cooling tower; dechlorination of cooling water; staff training; on-site spill response equipment; spill containment measures; wastewater treatment plant optimization studies.

**Suncor Inc. (Sarnia):** Recently completed and ongoing remedial measures include: ongoing program to reduce water use; sour water recovery system to reduce intake requirements; collection of steam condensate for re-use; pressurization of once-through cooling water to prevent contamination with hydrocarbons; treatment of recirculated cooling water; on-line sensor on influent of API separator to detect oil emissions to once-through cooling water; on-site spill response equipment; staff training. Suncor has also installed an in-stream GC analyzer to monitor river water intake, once-through cooling water discharge, and process water discharges for benzene, toluene, xylenes, ethyl benzene, and other chemicals in trace quantities.

**Terra International Canada Inc. (Courtright - formerly ICI Nitrogen Products):** Recently completed and ongoing remedial measures at Terra include: spill prevention programs including collection and recycling of process waters; elimination of chromium and chlorine in cooling tower water treatment; staff training; reduced once-through cooling water use; upgrade of air scrubber in urea granulation process. Upgrades to process equipment nitrogen solutions have resulted in a recycling of previously discharged product.



**Welland Chemical Ltd. (Sarnia):** Recently completed remedial measures at this facility include: new wastewater treatment system (1992) and changes in lagoon operations have significantly reduced phenols, cadmium, aluminum, trace metals, sulphide and chlorinated organics; conversion of water cooled compressors with air cooled compressors has greatly reduced water consumption and toxicity related to residual chlorine in intake water.

#### **Michigan Municipal**

In 1989 the MDNR implemented a CSO Control Program, to be implemented through the NPDES permit system, to eliminate or adequately treat all CSOs in Michigan. In the interim, all facilities are also

required to notify the MDNR, the MDPH and the local daily newspaper whenever there is an overflow. Progress on the CSO Control Program (as of March, 1994) and other Waste Water Treatment Plant (WWTP) remedial measures undertaken or planned since 1990 are documented below.

#### **Capac Waste Water Sludge Lagoons (WWSL):**

Capac has a three lagoon treatment system which discharges to the Belle River via Lemon Drain. The city has completed separation of combined sewers and is conducting the final flow tests for certification.

#### **St. Clair River Sewer Authority (East China Township WWTP):**

The WWTP has secondary treatment with phosphorus removal. There are no CSOs associated with this facility.

**Marine City WWTP:** This facility was converted to an activated sludge process in 1993. Grit and sludge handling, chemical addition and the feedback system were improved. Also, two final clarifiers and a new laboratory/office were added.

The process of sanitary and storm sewer separation was completed in 1994.

**Marysville WWTP:** Marysville WWTP is a trickling filter secondary plant with chemical phosphorus removal and effluent chlorination.

One combined sewer outfall has been discontinued. The City of Marysville has recently completed separation of all storm and sanitary lines comprising one combined sewer outfall. The last outfall must be separated by 2001, based on a long range plan approved by the MDNR. In addition, to separation, the City has installed monitoring stations on each outfall to the river which record volume of flow and sample discharges for certain water quality parameters.

**Port Huron WWTP:** The Port Huron WWTP is an activated sludge secondary treatment plant with

chemical phosphorus removal and effluent chlorination. A new outfall structure has recently been constructed for the Port Huron WWTP and the diffuser was raised from the bottom of the river to eliminate impacts to benthic fauna.

The WWTP submitted a CSO abatement plan to MDNR in December, 1992; final details are being negotiated. The plan includes a combination of sewer separation and containment basins to eliminate 20 CSO points including 10 on the Black River and 10 on the St. Clair River. The plan is to be implemented over the next 10-20 years.

**St. Clair WWTP:** This facility is a trickling filter secondary treatment plant with chemical phosphorus removal and effluent chlorination. Sewer separation was completed in 1994. Two lift stations have been replaced with newer units having increased capacity and an additional lift station has been added. The remaining older unit was replaced in 1994. One additional lift station is relatively new and will require only modifications to the flow monitoring equipment.

**St. Clair - Algonac WWTP:** The St. Clair County - Algonac WWTP is a rotating biological contactors secondary treatment plant with chemical phosphorus removal and effluent chlorination. A 480,000 gallon (1.817 million L) sludge storage facility was constructed at the plant. In addition, new sludge valves were installed in the primary tanks and one rotating biological contactor was replaced. There are no CSOs associated with this facility.

**Memphis Waste Water Sludge Lagoons (WWSL):** The City has a two lagoon treatment system, which discharges to the Belle River. In 1994, to increase treatment capacity, the City removed 20 years of sludge that had accumulated in the lagoons.

**Yale WWSL:** This facility discharges to the Black River via Mill Creek. The City constructed a third

stabilization lagoon in 1993. The two original lagoons were desludged in 1994. Separation of combined sewers was also completed in 1994.

### **Michigan Industrial**

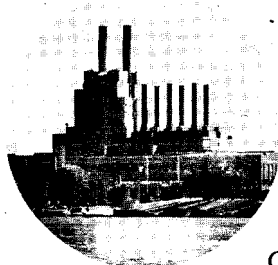
**AKZO Salt (St. Clair):** This facility has developed a Pollution Incidence Prevention Plan (PIPP) and pollution control manual. Spill prevention includes containment measures, daily inspections, pressure sensors to detect leaks, and best management practices relating to storage and handling of chemicals. Planned remedial measures include an additional storage tank for the wastewater treatment system to reduce the number of process wastewater overflows of brine to near zero.

### **Detroit Edison Company (Belle River, St. Clair and Marysville):**

Facility specific PIPP and Emergency Control Plans have been developed detailing spill notification and response procedures. The plans incorporate the requirements of the federal Spill Prevention, Control, and Countermeasure Plan, the hazardous waste (RCRA and Act 64) Contingency Plan, the *Toxic Substances Control Act* and the *Superfund Amendments and Reauthorization Act*. Spill containment measures have also been constructed.

**E. B. Eddy Paper (Port Huron):** This facility has a PIPP which includes spill notification and response procedures. Materials stored and the containment provided are nearly identical to that at James River (see below). This facility added an equalization tank to the wastewater treatment system in 1992.

**James River Corporation (Port Huron):** Remedial measures undertaken since 1990 include: isolation of process chemicals from waste streams; installation of alarm systems to warn of potential problems; reduction in amount of chemical handling reducing opportunity for spills and reduction in solid waste; new lamella settler to be installed in 1994 to reduce TSS content of process wastewater discharge;



development of a PIPP relating to spill prevention, notifications and response and including the construction of containment measures.

**Mueller Brass:** This facility is currently discharging all dry weather flows from the property to the City of Port Huron sanitary sewer system. The company is in the process of constructing a storm water collection system. All wet weather flow will be contained, treated and used as process cooling water. All surface water discharges were eliminated in 1994. It has developed a PIPP relating to spill notification and response.

### ▲ 4.3 Prioritization and Modelling of Sources for Remediation

#### ▲ 4.3.1 Sources of Fecal Coliform (*E. coli*) Bacteria for Remediation

Generally, the Ontario side of the river experiences higher bacterial counts than the Michigan side. The highest bacteriological count found in the river was at the CNR Ferry Dock sampling point downstream of Sarnia Bay.

There are three areas on the river that have CSOs and storm sewer outfalls. These are: Sarnia Bay and south Sarnia upstream of the WPCP; Port Huron and Marysville. At least two of these areas contribute significantly to localized areas of high coliform count. In Sarnia there is a highly contaminated area between the CNR Ferry Dock and Talfourd Creek. Port Huron CSOs contribute to water quality impairment particularly in the Black River.

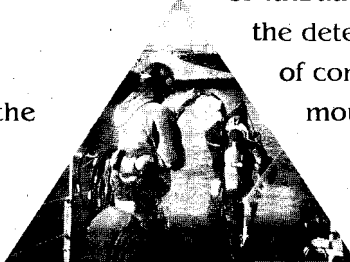
The high coliform counts appear to be localized within the main river channel; by the time the water reaches the South Channel in the delta, the bacterial water quality is significantly improved.

Loadings of coliform bacteria to the St. Clair River from a variety of point (and non-point sources) have

resulted in an impairment to the beneficial use of swimming (beach closings). This impairment needs to be addressed by point source remediation relating primarily to CSOs, sewage treatment plant effluents, storm sewer discharges and nonpoint sources.

#### ▲ 4.3.2 Ranking of Sources for Prioritization of Remediation

Generally the best available information on sources and loadings of contaminants relates to municipal and industrial outfalls. Information on CSO contributions is less well known for the St. Clair River AOC. Although ambient air quality data are available, there is as yet incomplete air emission data and determination of loadings to the river from atmospheric deposition have not been attempted. Other data gaps relate to bilge water quality and amounts contributed from shipping; contributions from contaminated sediments; and to the determination of specific causes and sources of contaminants which contribute to chironomid mouthpart anomalies.



In identifying remedial measures for the St. Clair River RAP, the Point Source Task Team first developed a ranking

system to determine priorities based on contaminant loadings from individual sources. Contaminant modelling based on various loading scenarios was undertaken for a limited number of contaminants to estimate downstream distributions in sediment and water. The results of the various model runs were then compared to the "yardsticks" and priority ranking to confirm remediation requirements.

In developing an evaluation methodology for ranking of sources, the primary goal was to provide a method or approach which would yield an objective evaluation. The methodology was modified from the Beak (1993; Chapter 4 in Appendix 4.3) approach by converting all contaminant yardsticks to a relative scale in which mercury is assigned a value of 100. Impact scores are then calculated by multiplying loadings by the relative yardstick. The assigned

yardstick values are also weighted by multiplying by the number of impairments affected. This ranking was considered as the "base case" which was subjected to a sensitivity analysis involving three other models for priority ranking, referred to as "trials". The trial cases were compared to the base case model to determine the relative sensitivity of various factors to the final ranking. The base case rankings were relatively insensitive to the variations represented by the three trials which provided support for the methodology employed.

The following illustrates the ranking methodology employed:

$$\text{Parameter Impact Score} = \text{No. Uses Impaired} \\ \times (100/(\text{parameter yardstick}/\text{mercury yardstick})) \\ \times \text{total loading}$$

Impact scores were calculated for each parameter for each medium (water, sediment, biota). These scores were then used to rank each parameter (highest score = lowest rank) resulting in a media-contaminant priority. Individual source rankings were then computed by multiplying the contaminant priority by the fractional contribution of each source to the total for that contaminant (for each medium).

The individual media scores were then summed to obtain a 'Total Quality Ranking' for each parameter by source. Table 4.1 presents this ranking according to facility. The issue of missing loadings data is not addressed with the ranking. This exercise only ranks identified loadings and does not differentiate between analyzed 'non-detects' and the absence of information.

### 4.3.3 Modelling and Use of KETOX to Evaluate Remedial Options

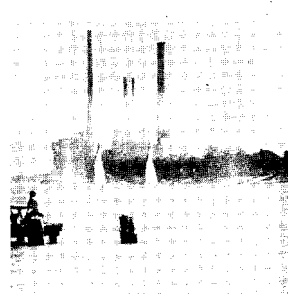
The OMOEE's KETOX model for the St. Clair River estimates contaminant concentrations in the water column and bed sediment downstream of single or

multiple sources. The KETOX model output can be displayed visually as a map using Geographic Information System (GIS) technology.

KETOX has been utilized for 8 parameters chosen to represent general classes of contaminants for which both ambient and effluent data were available. Output was utilized to estimate downstream ambient water and sediment quality concentrations related to various specified loadings scenarios. These concentrations were then compared to the appropriate yardsticks.

The parameters of concern for input to the model were:

- benzene
- carbon tetrachloride
- cadmium
- hexachlorobenzene
- lead
- mercury
- tetrachloroethylene
- zinc



The loadings data utilized for the model runs include: (1) RAP Stage 1 data (mostly 1986-1989 data); (2) RAP Stage 1 addendum data (mostly 1989/1990 data); (3) 'current' loadings determined from the latest monitoring data generated from each facility (mostly 1991 through 1993 data); and (4) 'projected' loadings based on ongoing and planned facility remedial measures (as of June 1994). The actual loadings employed for each of the four scenarios are provided in Appendix 4.2.

A description of the model, calibration techniques and results of its application for the four scenarios is provided in Nettleton (1994). The reliability of predicted exposure concentrations in water using the KETOX model depend mainly on the river flow variability, the loadings variability, and the calibration errors in the model. Generally river flow variability is

# Point Source Priorities for St. Clair River Remedial Action Plan Based on Net Loadings

(listed according to alphabetical order)

| Source                | Parameters                                                                                                                                                |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cole Drain*           | Hexachlorobenzene; Hexachlorobutadiene; Pentachlorobenzene; Octachlorostyrene; Nickel                                                                     |
| Dow Chemical          | Copper; Zinc; Hexachlorobenzene                                                                                                                           |
| Imperial Oil Refinery | Arsenic; Phosphorus                                                                                                                                       |
| Ethyl*                | Lead; Mercury; 1,2-Dichloroethane; 1,1-Dichloroethane; Carbon Tetrachloride; 1,1,2-Trichloroethane; Tetrachloroethylene; Trichloroethylene; PAHs; Toluene |
| Marysville WWTP*      | Phosphorus                                                                                                                                                |
| Novacor Petroleum*    | Arsenic                                                                                                                                                   |
| Polysar               | Benzene; Oil & Grease; Phosphorus                                                                                                                         |
| Port Huron WWTP*      | Cadmium; Phosphorus                                                                                                                                       |
| Sarnia WPCP*          | Zinc; Cadmium; Iron; Phosphorus; Copper; Nickel; Lead; Mercury                                                                                            |
| St. Clair WWTP*       | Mercury                                                                                                                                                   |
| Suncor                | Arsenic                                                                                                                                                   |

NOTE: only sources with source scores greater than or equal to 1.9 are reported above.

\* = no intake data available

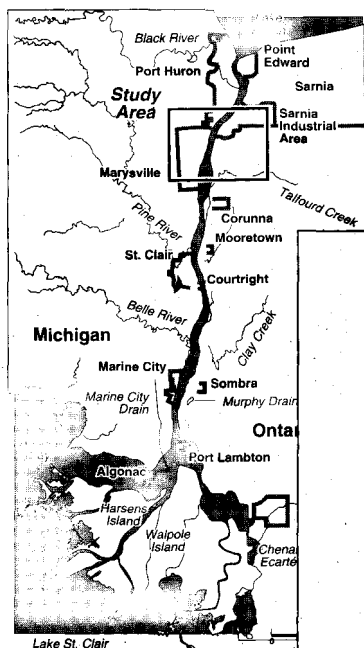
the least important source of error and loading variability is not a factor as input loadings are set based on defined targets. In the case of sediments, the hexachlorobenzene and mercury concentrations in the sediment measured during the 1990 benthic survey were much larger than those predicted by the model. As a qualitative observation, the measured concentrations do not appear much lower than those measured during the previous (1985) survey. This may indicate that a long time may be required for levels of these contaminants to approach the steady-state values predicted by the model for either current or projected loadings scenarios (P. Nettleton, OMOEE, pers. comm.). In fact a portion of the sediment-adsorbed chemicals might be permanently retained.

In combination with the associated source ranking, the model was used to assess the need for remediation. Where the model indicates that priority sources may not have sufficient reductions planned to ensure ambient water quality at or below the yardstick values, then additional performance

commitments would need to be negotiated with those facilities.

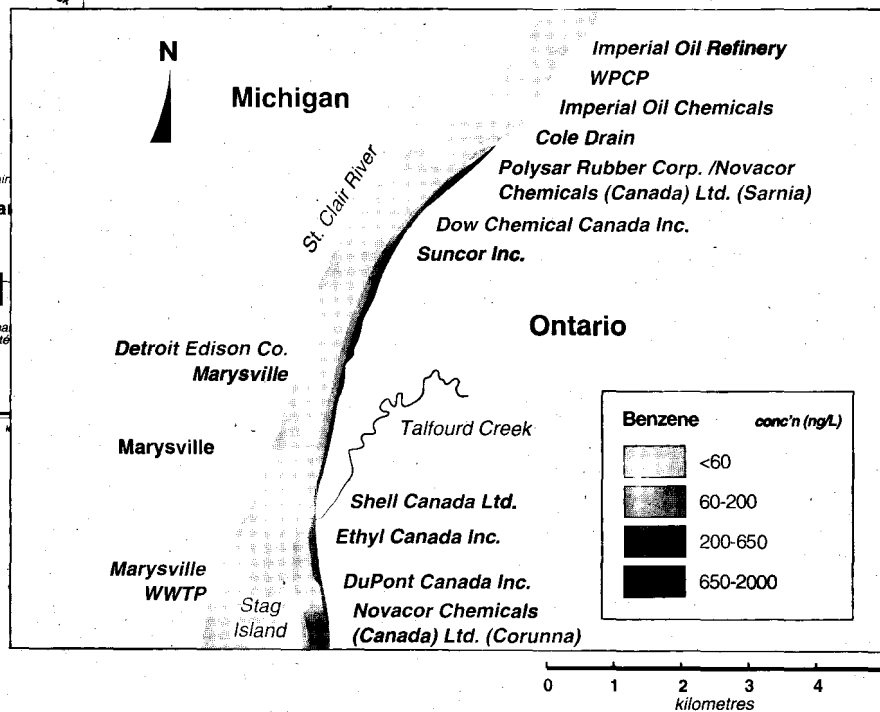
The output maps from each model run showing downstream concentrations in water and sediment are provided as Appendix 4.4; an example of the water model output for benzene is provided in Figure 4.2. Table 4.2 lists the estimated maximum downstream water and sediment concentrations for each of the eight parameters according to the four scenarios. Table 4.3 indicates where these predicted peak concentrations either exceed (+), approximate ( $\approx$ ), or are below ( $\sim$ ) the appropriate yardstick value for each of three scenarios (Stage 1 addendum, current, and projected loads). Exceeding a yardstick (or not) is based on model predictions of the current peak contribution of each source. Individual parameters in sediment and biota may exceed yardstick values due to historical contamination but appear in sections notes as "not exceeding yardsticks" and thus are not related to source control but to remediation needs for sediment and biota.

# HETOX Model Output Results for Benzene in Water

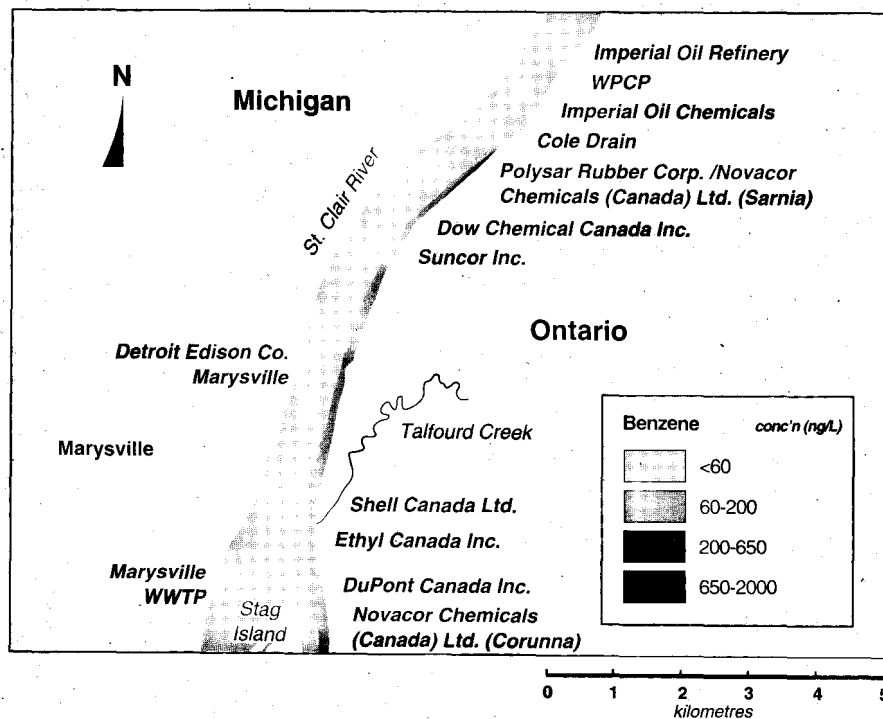


Benzene ( $\mu\text{g/L}$ ) in water  
 ('Yardstick' =  $6.6 \mu\text{g/L}$ )

4.2a Current loadings



4.2b Projected loadings



# Estimated Peak Concentrations in Water and Sediment From Each Model Scenario

(all values ppb) (based on data from Nettleton 1994).

| Chemical | Water<br>Yardstick | Sediment<br>Yardstick | Rap<br>Stage 1 | Rap Stage 1<br>Addendum |           | Current  |      | Projected |        |
|----------|--------------------|-----------------------|----------------|-------------------------|-----------|----------|------|-----------|--------|
|          |                    |                       | Water          | Water                   | Sed       | Water    | Sed  | Water     | Sed    |
| HCB      | 0.0001             | 10                    | 0.0033         | 0.00047                 | 15.0      | 0.001219 | 2-70 | 0.000352  | 11.1   |
| Mercury  | 0.011              | 200                   | 0.0152         | 0.0128                  | 145       | 0.0149   | 286  | 0.0123    | 110    |
| Benzene  | 6.6                | NY                    | 11.030         | 2.850                   | 140       | 2.848    | NM   | 0.609     | 29.6   |
| Zinc     | 30                 | 90,000                | 4.030          | 40.600                  | 1,470,000 | 4.870    | NM   | 2.610     | 94,700 |
| Cadmium  | 0.2                | 1,100                 | 0.0267         | 0.177                   | 2,620     | 0.177    | NM   | 0.177*    | 2,620  |
| Lead     | 2.9                | 31,000                | 0.281          | 2.480                   | 199,000   | 0.492    | NM   | 0.492*    | 61,300 |
| CTC      | 4                  | NY                    | 2.256          | 2.160                   | 82        | 1.070    | NM   | 1.070     | 8.1    |
| PERC     | 8                  | NY                    | 1.931          | 2.470                   | 379       | 1.137    | NM   | 1.090     | 29.6   |

NOTES: SED Sediment HCB hexachlorobenzene PERC tetrachloroethylene CTC carbon tetrachloride NM not modelled NY no yardstick  
\* projected and current loading identical thus projected scenario not run.

Table 4.3 indicates that three of the priority sources (as identified in Table 4.1) contribute directly to water quality yardstick exceedences based on the Stage 1 update loadings. This declines to two priority sources based on 'current' loadings and only one priority source according to the 'projected' loadings (hexachlorobenzene at Dow). For sediments, exceedences are related to a total of four priority sources using both the Stage 1 update loadings and the 'projected' loadings. Based on these estimates, loadings of zinc, lead and hexachlorobenzene will continue to contribute to impairments of beneficial uses in the St. Clair River sediments beyond implementation of all planned or ongoing remedial actions. Further reductions of these parameters will be required. In comparing the results of Table 4.3 with the priority rankings outlined in Table 4.1, it is apparent that, based on the Stage 1 Addendum and subsequent data, four of the top priority sources have demonstrated significant loading reductions since the Stage 1 report was released (i.e., not contributing to exceedences - mercury at Ethyl,

cadmium at Port Huron WWTP, benzene at Polysar, and cadmium and lead at Sarnia WPCP). If all planned and ongoing remedial measures are fully instituted, then an additional two priority sources will no longer contribute to water or sediment exceedences (hexachlorobenzene at Cole Drain, and lead at Dow).

The U.S.ACOE's RECOVERY model is a decision support model for screening the fate of in-place contaminated sediments in aquatic environments. It predicts the concentration of a contaminant in the water, the mixed sediment layer and in the deep sediments over time. The flux of the contaminant from the sediments into the water is also predicted. The total number of years for which the model is run is determined by approximating the time required for the toxic concentration in the water to decrease to 10% of the maximum value achieved, up to a maximum of 100 years (Sturgis et al. 1993). The RECOVERY model will be used in order to identify remedial options for in-situ contaminated sediment in the St. Clair River.

# Source Loadings Contribution to Exceedences (+) of Yardstick Values for Each of Three Model Scenarios

(based on data provided by Nettleton 1994).

| Facility/<br>Parameter    | Stage 1 Addendum    |       | Current  |       | Projected           |                     |
|---------------------------|---------------------|-------|----------|-------|---------------------|---------------------|
|                           | Sediment            | Water | Sediment | Water | Sediment            | Water               |
| Cole Drain - HCB          | -                   | +     | NM       | +     | -                   | -                   |
| Corunna WPCP - lead       | +                   | NM    | NM       | NM    | +                   | NM                  |
| Corunna WPCP - cadmium    | +                   | ≈     | NM       | NM    | +                   | ≈                   |
| Corunna WPCP - HCB        | -                   | +     | NM       | NM    | -                   | +                   |
| Corunna WPCP - PERC       | NY                  | -     | NM       | NM    | NY                  | -                   |
| Dow - zinc                | +                   | +     | NM       | -     | +                   | -                   |
| Dow - lead                | +                   | ≈     | NM       | -     | -                   | -                   |
| Dow - mercury             | -                   | +     | NM       | +     | -                   | +                   |
| Dow - HCB                 | +(1St) <sup>1</sup> | +     | NM       | +     | +(4St) <sup>1</sup> | +(3St) <sup>1</sup> |
| Dow - CTC                 | NY                  | -     | NM       | NM    | NY                  | -                   |
| Dow - PERC                | NY                  | -     | NY       | -     | NY                  | -                   |
| Ethyl - lead              | +                   | -     | NM       | -     | +                   | -                   |
| Ethyl - mercury           | -                   | -     | NM       | -     | -                   | -                   |
| Polysar - benzene         | NY                  | -     | NY       | -     | NY                  | -                   |
| Polysar - PERC            | NY                  | -     | NM       | NM    | NY                  | -                   |
| Polysar - CTC             | NY                  | -     | NM       | NM    | NY                  | -                   |
| Port Huron WWTP - cadmium | ≈                   | -     | NM       | -     | ≈                   | -                   |
| Sarnia WPCP - cadmium     | NM                  | -     | NM       | -     | NM                  | -                   |
| Sarnia WPCP - zinc        | +                   | -     | NM       | -     | +                   | -                   |
| Sarnia WPCP - mercury     | -                   | +     | NM       | NM    | -                   | +                   |
| Sarnia WPCP - lead        | -                   | -     | NM       | NM    | -                   | -                   |
| Sarnia WPCP - PERC        | NY                  | -     | NM       | NM    | NY                  | -                   |
| Shell Canada - benzene    | NY                  | -     | NM       | NM    | NY                  | -                   |
| Shell Canada - zinc       | +                   | -     | NM       | NM    | ≈                   | -                   |
| St. Clair WWTP - mercury  | -                   | +     | NM       | +     | -                   | +                   |

NOTES: HCB hexachlorobenzene  
- no exceedence of yardstick value

CTC carbon tetrachloride  
+ exceeds yardstick value for indicated media

PERC tetrachloroethylene  
≈ approximates yardstick value

NM not modelled  
NY no yardstick

<sup>1</sup> refers to sewer/outfall names (First, Third and Fourth Street Sewers)

## ● 4.4 Actions

The following actions are to be completed in accordance with the principles and priorities as outlined in the implementation strategy described in Section 10.2

### **Persistent and Bioaccumulative Substances,**

**Exceeding Yardstick: (\*)** All sources reduce discharges to meet yardstick (or better) at the end of the pipe no later than year 2000. Virtually eliminate contaminant from discharge by 2004. It shall be the responsibility of jurisdictional agencies to conduct regular open water quality monitoring and sediment and biological monitoring to assess the extent to which these substances are accumulating in the environment. Continue monitoring discharges at the source (discharge data provided by facility and/or regular or intermittent data provided by compliance sampling, etc.). Continue to strive for zero discharge.

#### **Priority Sources:**

Cole Drain - hexachlorobenzene

Corunna WPCP - cadmium,  
hexachlorobenzene

Dow - mercury, hexachlorobenzene

Sarnia WPCP - mercury

St. Clair WWTP - mercury

### **Persistent and Bioaccumulative Substances,**

**Not Exceeding Yardstick: (\*)** All sources virtually eliminate contaminant from discharge by 2004. It shall be the responsibility of jurisdictional agencies to conduct regular open water quality monitoring and sediment and biological monitoring to ensure that these substances are not accumulating in the environment. Continue monitoring discharges at the source (discharge data provided by facility and/or regular or intermittent data provided by compliance sampling, etc.). Continue to strive for zero discharge.

#### **Priority Sources:**

Ethyl - mercury

Port Huron WWTP - cadmium

Sarnia WPCP - cadmium

### **Persistent and Bioaccumulative Substances, Not**

**Modelled: (\*)** By analogy (to modelled parameters), or by modelling where sufficient data are available, determine if parameters that have not yet been modelled meet or exceed the yardstick. It shall be the responsibility of the jurisdictional agencies to ensure that persistent bioaccumulative substances from all sources are assigned to either category (exceeding or not exceeding yardstick) by December 1995. In the interim, continue with monitoring, as above, and operate under the assumption of virtual elimination by 2004. Continue to strive toward zero discharge.

#### **Priority Sources:**

Cole Drain - hexachlorobutadiene;

pentachlorobenzene; octachlorostyrene;

Ethyl - PAHs

### **Persistent Parameters of Concern (Potentially Bioaccumulative), Exceeding Yardstick: (\*)**

All sources meet yardstick (or better) at the end of the pipe no later than 2000 (based on bioaccumulative fraction - require speciated analysis in effluent and receiving water). Continue monitoring discharges at the source (discharge data provided by facility and/or data provided by compliance sampling, etc.). Jurisdictional agencies shall conduct regular open water quality monitoring. Continue to strive for zero discharge.

#### **Priority Sources:**

Corunna WPCP - lead

Dow - zinc

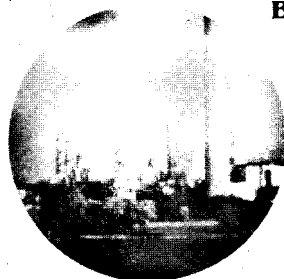
Ethyl - lead

Sarnia WPCP - zinc

Shell Canada - zinc

### **Persistent Parameters of Concern (Potentially Bioaccumulative), Not Exceeding Yardstick: (\*)**

All sources continue monitoring discharges at the end of pipe (based on bioaccumulative fraction - require speciated analysis in effluent and receiving water). Discharge data provided by facility and/or data provided by compliance sampling, etc. Jurisdictional



(\*) Contingent on emerging information and RAP priorities.

agencies shall conduct regular open water quality monitoring. Continue to strive for zero discharge.

**Priority Sources:**

Ethyl - carbon tetrachloride

Sarnia WPCP - lead

**Persistent Parameters of Concern (Potentially Bioaccumulative), Not Modelled:**(\*) By analogy (to modelled parameters), or by modelling where sufficient data are available, determine if parameters that have not yet been modelled meet or exceed the yardstick at the end of pipe (based on bioaccumulative fraction - require speciated analysis in effluent and receiving water). It shall be the responsibility of the jurisdictional agencies to ensure that substances from each source be assigned to either category (exceeding or not exceeding yardstick) by December 1995. In the interim, continue with monitoring, as above, and operate under the assumption of achieving the yardstick at the end of the pipe (or better) by 2000. Continue to strive for zero discharge.

**Priority Sources:**

Dow - copper

Imperial Oil Refinery - arsenic

Novacor Petroleum - arsenic

Sarnia WPCP - copper

Suncor - arsenic

**Persistent Parameters of Concern (Not Bioaccumulative):**(\*) All sources reduce discharges to the yardstick (or better) at the edge of the mixing zone no later than 2000, with no acute toxicity in mixing zone. Continue monitoring discharges at the source (discharge data provided by facility and/or data provided by compliance sampling, etc.). Jurisdictional agencies shall conduct regular open water quality monitoring. Continue to strive for zero discharge.

**Priority Sources:**

Sarnia WPCP - nickel

**Non-Persistent, Non-Bioaccumulative Parameters of Concern (Potentially Toxic):**(\*) Achieve

yardstick (or better) at the edge of the mixing zone by 2000. No acute toxicity in mixing zone. If monitoring suggests that some parameters are persistent in sediments then may require that yardstick be achieved at the end of pipe. Continue to strive for zero discharge.

**Priority Sources:**

Ethyl - 1,2-dichlorethane; 1,1-dichlorethane;  
1,1,2-trichlorethane; tetrachloroethylene;  
trichloroethylene; toluene

Polysar - benzene; oil and grease

**Non-Persistent, Non-Bioaccumulative Parameters of Concern (Not Toxic):**(\*) Achieve yardstick (or better) at edge of mixing zone by 2000.

**Priority Sources:**

Imperial Oil Refinery - phosphorus

Marysville WWTP - phosphorus

Polysar - phosphorus

Port Huron WWTP - phosphorus

Sarnia WPCP - iron; phosphorus



**Actions for Point Source Discharges of Bacteria:**

1. CSO control programs under the Michigan NPDES program will be fully implemented. Similarly, the remedial measures planned for the Sarnia WPCP will be fully implemented. The volume of non-treated overflows to the river will be reduced by 50% by 2000 and completely eliminated by 2005.
2. All sewage treatment plant effluents will be disinfected or treated using comparable methods in order to ensure a maximum of 200 counts *E. coli*/100 mL at the end of the pipe by 2000.
3. Segregated storm sewers will be monitored and control mechanisms put into place if bacteria levels exceed 200 counts *E. coli*/100 mL at the outfall.

**Actions for Point Source Discharges to Air:**

1. Probable sources within the AOC to supply an inventory of atmospheric releases for all

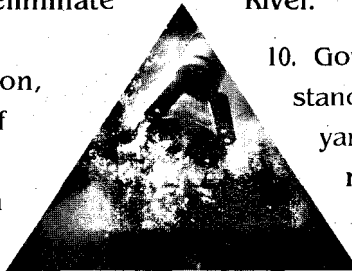
substances on the St. Clair River yardsticks list during 1994/1995, showing amount released regardless of the regulatory reporting criteria, so that contribution of air pollutants can be assessed.

2. Identify a means for determining the impact of air emissions on the St. Clair River by end of 1996.
3. On the basis of data reported or model results, the RAP Implementation Committee will attempt to determine whether local atmospheric discharges are impacting the St. Clair River and its watershed and if further action falls within the mandate of the RAP. Regardless, the RAP Team will recommend that the appropriate bodies pursue the issue of the control of atmospheric discharges and deposition.

#### **General Actions:**

1. All point sources (industrial, municipal, CSOs, treatment bypasses, stormwater) to eliminate spills to the river by 2000 through implementation of pollution prevention, process alteration, and installation of appropriate containment and treatment systems as well as through appropriate training in sound operating practices.
2. All facilities should implement process changes and/or modifications to achieve the targets they have planned and/or committed to (see Section 10). The RAP will detail these plans: anticipated means, level of commitment and time frame for achieving projected loads. All sources of contaminants on the list of concern not expected to achieve yardsticks should develop a pollution prevention/toxics use reduction plan by December 1995. This plan should include timetables for reductions. All facilities should report annually on the progress of implementation. The RAP Implementation Committee will prepare annual reports on changes in releases.
3. Where yardsticks do not exist for current contaminants of concern, all experts within and outside the AOC should be involved in the determination of a suitable means for setting a yardstick.

4. OMOEE and MDNR develop discharge permits on the basis of other discharges already approved or under application and assess total mass loadings to the river.
5. OMOEE and MDNR institute whole facility permitting systems to ensure that toxics are not shifted from one medium to another.
6. OMOEE and MDNR not permit any increases in the total loadings of the substances of concern to the St. Clair River or its tributaries.
7. When alternative processes, etc. are implemented, there should always be a net overall reduction to all media.
8. Responsible facilities eliminate all priority contaminants from leachate and other discharges to the Cole Drain (including Scott Road drain) by 2004.
9. Initiate sampling of Cole Drain in order to monitor loadings and effluent quality entering the St. Clair River.
10. Government agencies monitor changes in standards in each jurisdiction and revise yardsticks accordingly. If yardsticks are revised, repeat exercise of ranking sources and assessment of plans for lowering discharges. Make recommendations for lowering discharges further if necessary to meet yardsticks.
11. Federal, provincial, state and municipal governments educate small businesses and other toxics users and producers on how to conduct a comprehensive pollution prevention/toxics use reduction plan.
12. Pollution prevention/waste reduction or elimination/recycling are always the preferred options, all other things being equal.
13. Storm water impacts to be assessed as soon as the Ontario storm water control studies (required by the MISA limits regulations) are completed (3 to 5 years) and as soon as the Michigan storm water permitting reporting system is adequately operational (1 to 2 years).
14. Zero discharge will continue to be regarded as the ultimate goal.



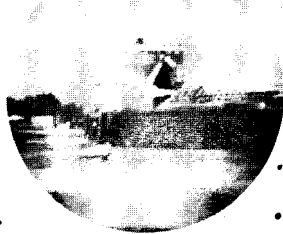
**C**ontaminants from non-point sources may have contributed to 5 of 9 beneficial use impairments. The impairments and associated contaminants are as follows:

- restrictions on fish consumption (mercury, PCBs);
- chironomid mouthpart anomalies (through water and sediment contamination);
- degradation of benthos (through sediment contaminated with copper, iron, lead, mercury, nickel, cadmium, zinc, total phosphorus and PCBs);
- restrictions on dredging (copper, iron, lead, mercury, nickel, cadmium, zinc, total phosphorus, PAHs and PCBs); and
- beach closings (bacteria from urban and rural runoff, domestic sanitary sources).

Based on available data, non-point sources including Lake Huron contribute at least ten percent of the total loadings to the St. Clair River for the following parameters: copper, iron, lead, mercury, nickel, cadmium, cobalt, PAHs and PCBs. In addition, non-point phosphorus and zinc contributions are close to ten percent of the total loadings. Additional parameters of concern are also suspected to be associated with non-point source loadings, but require additional investigation.

Six major non-point sources of contaminants in the watershed were identified and include:

- urban storm runoff (point source task team responsible for storm runoff from industrial sites);
- rural storm runoff;
- waste sites without leachate and runoff collection (waste sites with leachate collections systems addressed by point source task team);
- malfunctioning septic systems;
- all domestic sources not connected to municipal treatment facilities; and
- generation and disposal of household hazardous waste (HHW).



A complete Non-Point Source Work Plan is provided in Appendix 3.2. This work plan represents actions taken by the Non-Point Source Task Team for the development of the Stage 2 RAP. It is comprised of four components which are summarized below. These tasks do not represent recommended actions resulting from task team deliberations. Recommendations (actions) are summarized at the end of this chapter. Work Plan components include:

#### **Urban and Rural Storm Runoff**

- Identify and monitor sources contributing to storm runoff;
- Assess types and causes of "controllable" pollutants (chemicals, nutrients, bacteria, sediments, road salt);
- Identify measures to control urban and rural storm runoff;
- Implement control measures; and
- Evaluate the environmental effectiveness of prevention measures.

#### **Waste Disposal Sites**

- Compile and evaluate waste site information;
- Recommend action where an identified concern exists;
- Ongoing monitoring of all sites;
- Implement control measures; and
- Evaluate the environmental effectiveness of prevention measures.

#### **Domestic Sanitary Sources**

- Identify and document conditions in the St. Clair River, its tributaries and beaches;
- Identify problem areas;
- Document municipal initiatives;
- Mandate ongoing maintenance of private sewage disposal systems;
- Develop and implement remedial actions; and

- Evaluate the environmental effectiveness of prevention measures.

### Household Hazardous Waste

- Promote public education and awareness to minimize waste production and to encourage proper disposal and handling.

## ▲ 5.1 Regulatory Programs

Legislation and programs relating to the regulation of non-point source contamination are described in Appendix 4.1 and summarized below.

### ▲ 5.1.1 Ontario and Canada

There are limited controls for urban and rural/agricultural runoff under the *Ontario Water Resources Act* and the *Environmental Protection Act*. Additional programs relating to the control of runoff include: the Soil and Water Environmental Enhancement Program (SWEEP) used to educate farmers about new technologies, benefits of crop rotation, and other soil conservation practices; Land Stewardship II Program provides incentives for conservation of agricultural lands; manure handling practices are identified by the Farm Pollution Advisory Committee (FPAC).

Interim Stormwater Quality Guidelines have been developed jointly by OMOEE and OMNR to address the need for stormwater quality management in development areas in Ontario. These guidelines apply only to new developments. Stormwater drainage plans and management practices are encouraged through the Ontario Drainage Management Program (ODMP) and funds for municipal stormwater abatement are provided through OMOEE's Pollution Control Planning Program (PCP).

Ministry approved industrial waste disposal sites including all activities associated with hazardous waste (i.e. handling, shipping, disposal, site

management) are regulated under the *Environmental Protection Act* Waste Management-General Regulations and related policies.

The provincial *Pesticides Act* (1980) prohibits the improper use and storage of pesticides. The Ontario Ministry of Agriculture and Food's Food System 2002 is a comprehensive program to assist growers to cut their use of pesticides in half by the year 2002 through research and development, education and changes in field delivery.

Installation and operation of private sewage treatment systems is controlled under Regulation 358 under the *Ontario Environmental Protection Act* (EPA). Several recommendations regarding the installation and operation of private septic systems have been proposed by the Sewell Commission.

### ▲ 5.1.2 Michigan and the United States

Urban stormwater and/or snow melt induced runoff is controlled through the Non-point Source Control Program (NPS) and the Stormwater Control Program (SCP). The NPS program addresses both urban and rural/agricultural non-discrete runoff

sources and provides funds for the design and implementation of control measures. The SCP program addresses runoff associated with discrete point sources such as storm sewers. It regulates runoff from construction sites that disturb five acres (2 ha) or more of land and have a point source discharge of storm water into a municipal separate storm sewer or waters of the state. Small and large industrial sites are mostly regulated through general storm water permits, with some requiring individual permits. Municipalities with populations of 100,000 or more that discharge to a municipal separate storm sewer system require a municipal storm water permit.

Agricultural runoff is principally addressed through the U.S. Department of Agriculture (USDA) Natural Resource Conservation Service - NRCS (formerly Soil Conservation



Service - SCS) and the Cooperative Extension Services (CES). Both agencies provide education and expertise to farmers regarding soil erosion and management practices as well as animal waste control and use of pesticides. The USDA, Natural Resource Conservation Service (Soil Conservation Service) has also implemented several agricultural programs in portions of the St. Clair watershed that are used to apply conservation practices to highly erodible land. The Integrated Crop Management Program ensures that nutrients and pesticides are applied to cropland in an efficient and environmentally sound manner.

The *Michigan Hazardous Waste Management Act*, Act 64, Public Acts of 1979, as amended, regulates the generation, use, transport, storage, and disposal of hazardous wastes within Michigan. The *Michigan Environmental Response Act*, Public Act 307 of 1982, as amended (MERA), and its administrative rules, provide for the identification, risk assessment, evaluation and clean up of sites of environmental contamination in the State.

Pesticide use in Michigan is regulated by the *Pesticide Control Act*, Michigan Act 171 of 1976 as amended. The Michigan Department of Agriculture "Clean Sweep" program allows farmers and chemical distributors to turn in out of date chemicals for proper disposal.

Installation and operation of septic tank/tile field disposal facilities are regulated through a cooperative program involving the MDNR and the local County Health Department under the provisions of Act 245, Public Acts of 1929, as amended.

## ■ 5.2 Remedial and Prevention Measures and Actions in Progress

### ■ 5.2.1 Remediation and Prevention Approaches

Non-point source problems will be addressed through comprehensive watershed management

planning. Remedial and preventative measures for each non-point source are summarized as follows:

#### **Urban Runoff**

Schroeter and Associates (1992) conducted an Ontario, Great Lakes basin wide study which provided estimates of annual loadings for 26 toxic contaminants in urban stormwater runoff, combined sewer overflows and sewage treatment plant effluents. Results, in terms of total solids loadings, showed that surface runoff generated 49 to 96% of the total; overflows and combined sewers accounted for 1.5 to 20%; and sewage treatment plant effluents contributed 4 to 39% of the total (Schroeter and Associates 1992).

There are three general remediation approaches:

- pollution prevention;
- pollution control; and
- land use policy/planning.

#### **Rural Areas**

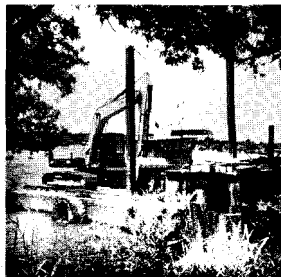
Tributaries subject to rural runoff have been identified as a contaminant source in the St. Clair River watershed; remedial options include:

- control soil loss;
- proper storage and handling procedures for manure; and
- reduction in, and proper use of, pesticides.

#### **Waste Disposal Sites**

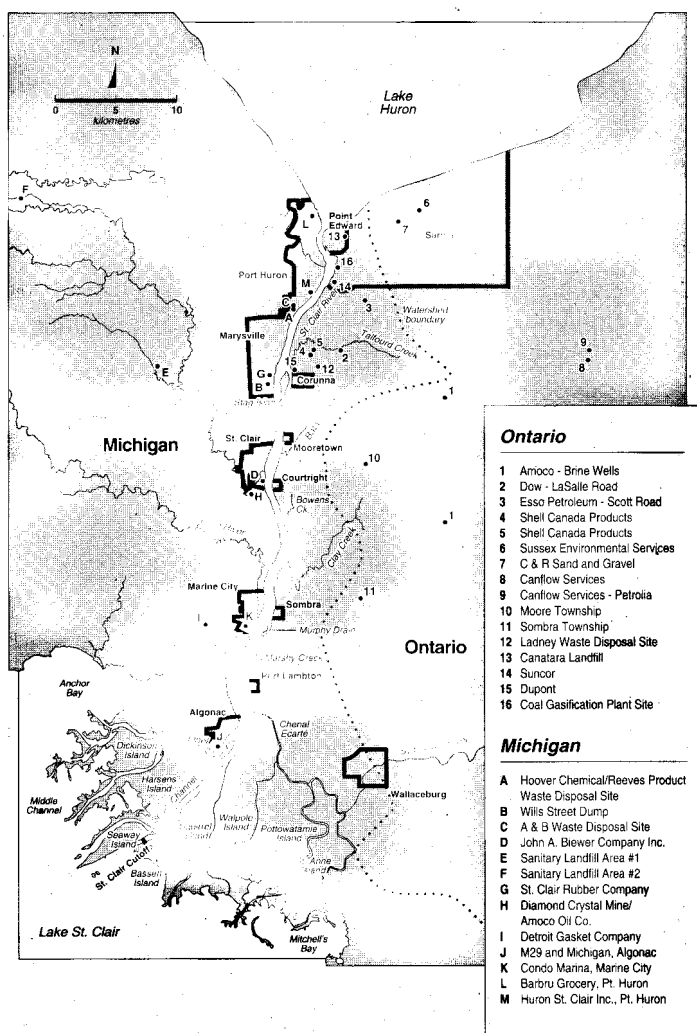
Options related to problems encountered with industrial and municipal landfill sites include:

- landfill design;
- construct leachate collection and treatment systems;
- regular monitoring programs for problem detection;
- alternative treatments such as removal or solidification of liquid waste;



# Location of Waste Disposal Sites, Landfills and Leaking Underground Storage Tanks Without Leachate or Runoff Collection Systems

(sites identification keyed to text)



- decrease the quantity of waste sent to landfills, reduce, reuse and recycle;
- retrofitting existing landfills to meet current standards; and
- mitigation and remediation of contaminated shallow groundwater.

Waste disposal sites and landfills are potential sources of groundwater and surface water contamination. The Non-Point Source Task Team was responsible for evaluating waste disposal sites without leachate and

runoff collection systems. Waste disposal sites with leachate and surface water collections systems are the responsibility of the Point Source Task Team.

The Non-Point Source Task Team used the Stage 1 document and Technical Options report (Beak 1993; Part A, Section 3.5 in Appendix 4.3) and Michigan 307 report (1994) in order to identify all sites not having leachate and collection treatment systems. The Ontario site list (Table 5.1) was submitted to the OMOEE district office to provide the Non-Point Source Task Team with the most recent available information. These data were used to evaluate each site (Table 5.1 and Figure 5.1). Results for Ontario sites revealed that there is not enough information available to make an assessment for three waste disposal sites and three landfill sites (Table 5.1). Two potential problem sites were identified, the Ladney Waste Disposal Site and the Canatara Landfill.

The Ladney Waste Disposal Site operated in the late 1950s and early 1960s receiving a variety of industrial wastes both as bulk waste and in drums. Upon closure, actions to cover exposed tar and open pits was unsatisfactory. In 1979 OMOEE issued a Control Order to solidify and cap two lagoons containing styrene tar. Work required by this order was completed in 1981. In the spring of 1990 an oil like substance was observed seeping from the Ladney site into a drainage ditch that eventually drains into Baby and Talfourd Creeks. During the summer of 1990 an attempt was made by the owner to stop the flow of liquid waste and clean up the accumulated material in the ditch. This work was completed, however oil/tar has since been observed moving up through the lagoon clay caps to the surface. Remedial actions are pending.

The Ladney Waste Disposal Site was inspected on February 22, 1994. During this inspection 177 electrical capacitors were found. Subsequent tests confirmed that each capacitor contained 5 to 10 litres (1.32 to 2.64 U.S. gal) of almost pure PCBs.

The capacitors and some PCB contaminated soil have been secured in 45 gallon (54 U.S. gal) drums which in turn have been put in a locked container, approved for PCB storage, that remains on the site. An investigation is ongoing to determine the source of the capacitors. In June, 1994 Golder and Associates commenced a hydrogeologic investigation and assessment of only the PCB contaminated area on the Ladney site.

#### Study objectives include:

- (1) Determine if additional capacitors are buried in the vicinity of those already found at the site;
- (2) Determine the lateral and vertical extent of PCB contamination in the soil; and
- (3) Determine the most appropriate clean up measures for the contaminated soil.

The Canatara Landfill Site is a closed and covered landfill site that is part of Canatara Park in Point Edward. During the 1930s and 1940s chemicals and other wastes were disposed of at the site. A pollution survey in 1992 revealed that the site was generating hazardous levels of methane gas at its perimeter. Floating oil products were observed in surface water at several locations, and benzo(a)pyrene was detected in the shallow groundwater zone, however impacts on the St. Clair River have not been documented. The report identifies several areas where follow-up investigations should be done in order to determine the area, extent and intensity of contaminants. A follow-up study will be used to determine remedial options for the site.

Studies will be conducted in order to properly assess the waste disposal sites and landfills for which there is limited or no information (Table 5.1).

Michigan waste disposal site information was provided by MDNR to the Non-Point Source Task Team. Since the 1991 Stage I RAP was published many additional contaminated sites have been identified in Michigan and cleanup procedures have been initiated for

## Status of Ontario waste disposal sites, landfills and injection wells.

*The Non-Point Source Task Team is responsible for waste sites and landfills with no leachate or surface water collection system.*

### Waste Disposal Site or Landfill With No Leachate or Surface Water Collection System

#### Problem Status

|                                                          |                                                       |
|----------------------------------------------------------|-------------------------------------------------------|
| Dow, LaSalle Road                                        | Do not know the impact of lime sludge                 |
| Dupont                                                   | Inadequate information available for assessment       |
| Shell Canada (two sites)                                 |                                                       |
| Walpole Island Landfill                                  |                                                       |
| Moore Township Landfill                                  |                                                       |
| Sombra Township Landfill                                 |                                                       |
| Amoco (brine well)                                       | No evidence of problems                               |
| Imperial Oil Refinery                                    |                                                       |
| Suncor Inc.                                              |                                                       |
| Sussex Environmental Services Inc.                       |                                                       |
| C & R Sand and Gravel Ltd.                               |                                                       |
| Canflow Services - Petrolia and Enniskillin sites        |                                                       |
| Coal Gasification Plant Site - Maxwell and Water Streets |                                                       |
| Ladney Waste Disposal Site                               |                                                       |
| Canatara Landfill (closed)                               | Localized contamination problems and no known effects |

### Waste Disposal and Landfill Sites with Leachate and Surface Water Collection and Treatment Systems (Responsibility of Point Source Task Team)

|                                             |
|---------------------------------------------|
| Dow, Scott Road Site                        |
| Imperial Oil Refinery                       |
| Fiberglas Canada Inc.                       |
| ICI Canada Inc., Courtright                 |
| Nova Petrochemicals, Corunna                |
| Ontario Hydro, Courtright                   |
| Polysar Rubber Corporation, Scott Road Site |
| Shell Canada (Landfarm)                     |
| Welland Chemicals Ltd.                      |
| Unitec Disposal Inc.                        |
| K & E Solid Waste Management Site           |
| City of Sarnia Landfill                     |

some. Currently identified are 153 contaminated waste sites (307 sites) and Leaking Underground Storage Tank (LUST) sites in St. Clair County. Assessment and cleanup responses have been

Identified Michigan Act 307 and leaking underground storage tank (LUST) sites in St. Clair County for which no clean-up or assessment Action has been initiated (as of January 1994).

| Waste Site                                          | Contaminant/Contaminant Type                       | Rank |
|-----------------------------------------------------|----------------------------------------------------|------|
| <b>Act 307 Sites (No Clean Up Action Initiated)</b> |                                                    |      |
| A & B Waste Disposal                                | BTEX, TCE, PCE.                                    | 24   |
| Detroit Gasket Company                              | toluene                                            | 29   |
| Hoover Chemical Reeves Product                      | methylene chloride, paints/resins                  | 22   |
| John A. Biewer Company                              | chromium, copper                                   | 20   |
| M29 and Michigan, Algonac                           | gasoline                                           | 21   |
| Sanitary Landfill Area No. 1                        | chromium                                           | 27   |
| Sanitary Landfill Area No. 2                        | domestic commercial, light industrial              | 18   |
| St. Clair Rubber Co., Marysville                    | heavy manufacturing                                | 20   |
| St. Clair Rubber Co./Wills Street Dump              | heavy manufacturing, zinc, TCE, lead, ethylbenzene | 27   |
| <b>LUST Sites (No Clean Up Action Initiated)</b>    |                                                    |      |
| Condo Marina, Marine City                           |                                                    |      |
| Barbru Grocery, Port Huron                          |                                                    |      |
| Huron St. Clair Inc, Port Huron                     |                                                    |      |
| Amoco #0009, St. Clair                              |                                                    |      |

Note: BTEX benzene, toluene, ethylbenzene, xylenes  
PCE perchloroethylene, tetrachloroethylene TCE trichloroethylene

initiated for 140 of these sites. Of the remaining 13 sites, 9 are designated 307 sites, the other 4 are sites with leaking underground storage tanks (Table 5.2). Currently, none of the sites in St. Clair County are on the list 307 Highest Ranking Sites requiring immediate clean-up. There are no documented effects to the St. Clair River or its tributaries from these sites.

Migration of contaminants from deep injection wells to the freshwater aquifer, and subsequently to the St. Clair River may be the result of several factors that promote potential contamination. These include: (1) numerous bore holes, drilled for oil and gas exploration, if improperly closed will act as channels through bedrock to the aquifer, especially if the lower formations are under excessive pressure; (2) poorly constructed injection wells may allow waste to leak through casings; (3) pressurized waste may travel along faults in the bedrock; and/or (4) pressurized waste may migrate through permeable limestone and shale to the freshwater aquifer. Figure 5.2 shows the location of waste disposal wells in Ontario and Michigan.

Because deep well injection is no longer used for the disposal of industrial wastes, technical options are limited to:

- proper closing of bore holes and existing injection wells;
- regular monitoring of groundwater; and
- mitigation and remediation of contaminated groundwater.

#### Domestic Sanitary Sources

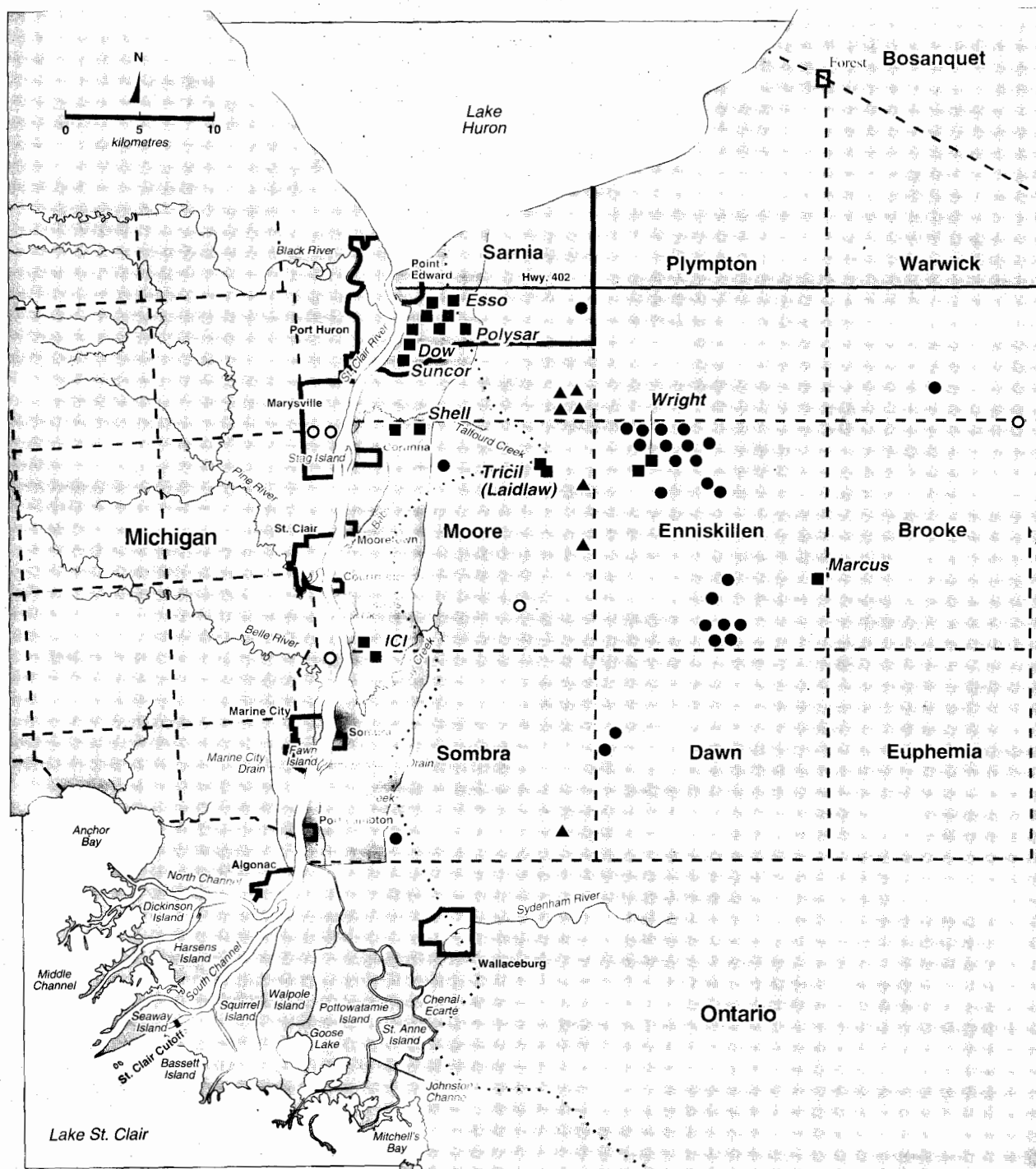
Sanitary waste disposal practices of individual households and recreational boats in the St. Clair River watershed contribute to water quality problems; control options include:

- maintain septic systems;
- correct direct discharges of untreated sewage; and
- prevent pollution from pleasure boats.

#### Non-domestic Discharges to Sanitary Systems

Non-domestic sanitary sources contribute to loadings discharged by way of the water pollution

# Location of Waste Disposal Wells in the St. Clair River Area of Concern



- Liquid industrial waste - injections discontinued
- ▲ Cavern-Washing Brine injected into the Detroit River Group
- Oil-Field Brine injected into the Detroit River Group
- Oil-Field Brine injected into the Guelph Formation
- All waste injections prohibited (8 km in from St. Clair River)
- - - Township line
- ..... Watershed boundary

control plants/wastewater treatment plants; control options include:

- pollution prevention initiatives; and
- treatment of non-domestic waste prior to discharge to the sanitary system

### **Household Hazardous Waste**

Persistent toxic chemicals are contained in such common household products as: household cleaners, pool chemicals, paint, solvents, pesticides and herbicides, fertilizers, wood preservatives, metal and furniture polishes, some medications, chemicals in pet collars and insect sprays/powders, photographic chemicals, antifreeze, batteries and used motor oil. Control of household hazardous waste is best achieved through public education and awareness to minimize waste production and encourage proper handling and disposal.

Beak (1993; Part A, Section 3.1 in Appendix 4.3) identified technical/remedial options for each category through a review of relevant literature, discussions with experts and questionnaires distributed to the general public and interest groups.

## **● 5.2.2 Ongoing Programs**

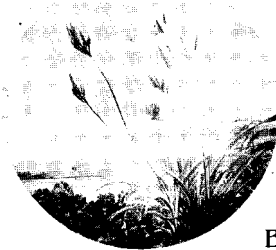
### **Ontario Rural Runoff**

There are a number of programs in place in the St. Clair River watershed, available to those concerned with ongoing and potential contamination of the river and its tributaries as a result of rural practices.

The local Ontario Ministry of Agriculture and Food and Rural Affairs (OMAFRA) District Office in Lambton, Agriculture and Agri-Food Canada, the St. Clair Conservation Authority, and the Soil and Crop Improvement Association (OSCIA) have been active in devising and implementing farm conservation practices. Each program is geared toward the ultimate goal of preserving farmland over the long term and

initiating practices that promote conservation tillage and address pollution at the source. These programs are summarized below and information is provided in more detail in Beak (1993; Part A, Section 3.4 in Appendix 4.3) and in Appendix 5.1.

**Clean Up Rural Beaches (CURB) Program:** CURB is a province wide program with a mandate to identify agricultural sources of contamination of rural beaches. It is administered through local conservation authorities. Cooperative work involving OMOEE, Lambton Health Unit and St. Clair Region Conservation Authority has permitted an evaluation of water quality at beaches and tributary outflows to the St. Clair River. As a result of studies undertaken in 1993 and at the urging of BPAC, CURB funding has been approved for Clay Creek and Baby Creek watersheds.



**Permanent Cover II Program:** The Permanent Cover II program is a federal initiative started in September, 1992. The focus of the program is the permanent retirement, protection and maintenance of fragile agricultural land on a farm in exchange for 15 years rent from Agriculture Canada. Benefits of this program result in reduced erosion on lands adjacent to water courses and reduced risks to farmers.

### **Federal Activities Under the Canada-Ontario Agriculture Green Plan**

This plan was developed to conduct projects relating to eight priority issues facing the Canadian agriculture-food sector. In Ontario four issues are being investigated and include: soil quality; water quality; wildlife/wetlands/woodlands management; and waste management. Program duration is from September 21, 1992 to March 31, 1997. Resultant federal programs are outlined below.

**Environmental Farm Plans:** This program allows each farm to develop its own proactive environmental agenda. The program is administered by the Ontario Soil and Crop Improvement

Association (OSCIA) under contract to the Ontario Federation of Agriculture. Farm plans are developed and submitted for funding consideration.

**High Crop Residue Program:** This federal initiative is targeted at taking erodible slopes out of production and reducing the amount of sedimentation in nearby water courses by utilizing high crop residue management. The program allocates per acre grants (up to \$10,000) to farmers willing to leave more residue from previous crops on their fields than traditionally practised.

**Rural Conservation Clubs:** This program is a federal (Agriculture and Agri-Food Canada) initiative linked to Canada's Green Plan and provides up to 50% financial support for innovative research and demonstration projects. Project categories include manure utilization, cover crops, conservation cropping, tillage systems, and wetland, woodland or wildlife habitat. As of September 29, 1993, approximately 42 projects have been approved.

**Wetlands/Woodlands/Wildlife:** Activities include ten projects for study plus a best management practices (BMP) manual, technology transfer and administration components by the Canadian Wildlife Service.

**Technology Transfer/BMP Manuals/Information Centre:** A series of BMP manuals have been published to date.

**Research:** Activities include soil and water research related to on-farm, monitoring and evaluation, nutrient management and "closed loop". Administered by Agriculture Canada's London Research Centre.

**Administration/Evaluation/Communication:** Administration of the federal programs including salaries, capital, evaluation of the program and communications activities are included.

## **Ontario Domestic and Sanitary Sources**

**The Ontario Clean Water Agency:** In February, 1993 the provincial government announced the creation of "The Ontario Clean Water Agency". The Agency will assist municipalities to plan and develop sewage systems and act as a source of technical information.

### **Corunna/Mooretown (Moore Township):**

Construction of new sewers up to the St. Clair Parkway (Lots 42 to 48 and 8th Line). Project commenced in 1993.

**Sombra Township (8th Concession):** Construction of a gravity sewer, forcemain, a new pumping station and related works. All sewage will be treated and diverted from the St. Clair River. Project commenced in 1993.

### **Sombra Township (13th and 14th Concessions):**

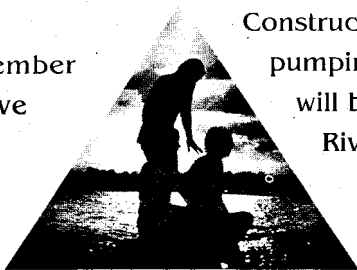
Construction of gravity sewers, forcemains, a new pumping station and related works. All sewage will be treated and diverted from the St. Clair River. Project commenced in 1993.

### **Sombra Township (9th and 10th**

**Concessions):** Construction of gravity sewers, forcemains, a new pumping station and related works. All sewage will be treated and diverted from the St. Clair River. Project commenced in 1993.

## **Great Lakes Pollution Prevention Community Assistance Project**

The Great Lakes Pollution Prevention Community Assistance Project is an 18 month long project, initiated by WRITAR (Waste Reduction Institute for Training and Research), to develop and demonstrate a detailed planning and early implementation process for pollution prevention, yielding source reduction activities which address specific priority pollutants. The project is supported by the Great Lakes Protection Fund (GLPF) and utilizes the RAP public participation process for advancing pollution prevention in the communities.



This project focuses on pollution prevention, community groups, and technical assistance to industry in two AOCs, one of which is the St. Clair River. This Community Assistance Project aims to integrate all these types of targeted activities in a community-wide, community-initiated process that is self-sustaining over time. Activities to date include participation by two fabricated metal products manufacturers discharging to the Sarnia sewage treatment plant. Pollution prevention opportunities will be explored to identify ways to reduce loadings to the sanitary sewage system, and communicate these findings to other local manufacturers within the same industrial group. A workplan for WRITAR's activities in the St. Clair River watershed is provided in Appendix 5.1.

### **Michigan Runoff**

Michigan Department of Natural Resources (MDNR) NPS program provides grants for locally sponsored projects for design and implementation of non-point source control measures based on Best Management Practices (BMPs). The program is primarily voluntary rather than being permit/enforcement oriented. The NPS program has developed BMP guidebooks for agriculture, forestry, construction and golf courses. Programs that are part of the NPS include:

**The Michigan Department of Agriculture Clean Sweep Program** allows farmers and chemical distributors to turn in out of date chemicals for proper disposal. Several, one day collection sites were set up over a one week period in 1993 and 1994 for St. Clair County.

**Clean Stream Program** which samples rivers and educates landowners specifically for pesticides and nutrients in rivers and streams; and

**Animal Waste Control Program** assists and educates livestock owners with less than 400 animals in waste management practices.

Agricultural runoff is principally addressed through the Natural Resource Conservation Service (Soil Conservation Service) and the Cooperative Extension Services (CES). Michigan Cooperative Extension Services are institutions that facilitate outreach and education/informational exchange between researchers at land grant universities and the growers. The United States Department of Agriculture (USDA) Natural Resource Conservation Service (Soil Conservation Service) provides technical expertise to farmers on soil management. The Farm Service Agency - FSA (Agricultural Stabilization and Conservation Service - ASCS) of the USDA provides direct federal payments to growers/farmers who participate in programs administered by SCS under the 1985 and 1990 "Farm Bills".

The USDA Natural Resource Conservation Service

(Soil Conservation Service) has also implemented several agricultural programs in portions of the St. Clair watershed. SCS has set forth policy on "Highly Erodible Land" where approved conservation techniques must be applied to all highly erodible land used to produce an agricultural commodity. In St. Clair County 3,500 acres (1,416 ha) have been

designated as highly erodible and are practising approved conservation techniques.

**The Agricultural Cost Share Program** uses a variety of approved practices that can be implemented on cropland; such as no-till, tree planting, permanent hay cover, grass waterways, animal waste systems, etc. The Soil and Water Conservation Service in St. Clair, Lapeer and Sanilac counties cost shares with each landowner for up to 3 years. Seventy-five to eighty percent of landowners who have been involved in the cost share program continue to maintain conservation practices used in the program.

**The Integrated Crop Management Program** is a new program to St. Clair County which ensures



that nutrients and pesticides are applied to cropland in an efficient and environmentally sound manner.

Commencing October 1994, the U.S. Department of Agriculture through the Soil and Water Conservation Districts initiated a **Southeast Michigan River Basin Study and Environmental Action Plan**. This study includes St. Clair County and will follow through with county resource plans by 1996. This project will culminate in the development of a plan addressing non-point source issues. Several federal state and local agencies, organizations and other interested parties will participate in the project.

### ● 5.3 Actions

The following actions are to be completed in accordance with the principles and priorities as outlined in the implementation strategy described in Section 10.2.

#### **Watershed action:**

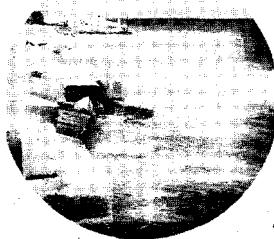
1. Preparation of Watershed/Subwatershed Management Plans.

Draft watershed management plans focusing, in part, on contaminant reduction measures will be developed within existing regulations, policies and programs by 1997.

#### **Urban storm runoff actions include:**

1. For areas under development, attempt to maintain the pre-development hydrography through maintenance of natural infiltration pathways for stormwater and hence minimize surface runoff and peak flows during storm events by 2000.
2. All new developments will be designed in order to maximize (protect, enhance and/or restore) existing natural features. 1995 and ongoing.
3. Construct on site controls to remove pollutants at existing sites by 2000.

4. Bylaws/subdivision agreements will be enforced to ensure developments incorporate on-site pollution control. 1994 and ongoing.
5. Educate the development industry and municipalities. 1995 and ongoing.
6. Monitor to quantify the effectiveness of various treatments. 1993 and ongoing.
7. Urban and rural stormwater management should be linked through common watershed management plans. 1994 and ongoing.
8. Reduce the use of road salt, and explore the use of alternative de-icing products. 1994 and ongoing.
9. Reduce excessive use and application of fertilizers and pesticides for lawn care maintenance and, wherever possible, employ the use of alternative products and different lawn care methods. 1994 and ongoing.



#### **Rural storm runoff actions include:**

- (1) Agricultural practices
  - Promote the utilization of current programs, i.e. land stewardship. Ongoing since 1993.
  - Promote the uptake of new technology and management practices i.e. minimum till, no till, manure injection, etc. Ongoing since 1993.
  - Monitor test results (i.e. sampling of milk house wastes, sediment loading). 1994 and ongoing.
  - Reduction in the use of pesticides and fertilizers. 1994 and ongoing.
- (2) Land Use Management
  - Promote maintenance of existing wetlands and forest. 1993 and ongoing.
  - Incorporate stormwater management and watershed or subwatershed planning into the Official Plans for individual municipalities. Check status and promote. 1995 and ongoing.

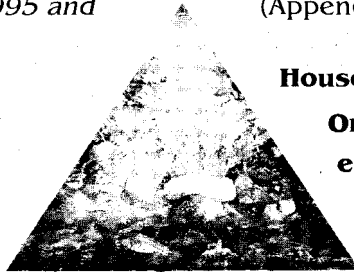
- Implement remedial and preventative measures, as appropriate, for Clay Creek and Baby Creek watersheds under approved funding from the "Clean Up Rural Beaches" (CURB) Program in Ontario. *1993 and ongoing.*

**Waste site remedial actions identified by the non-point source task team include:**

1. Create incentives and increased opportunities for proper disposal of wastes. *Phase-in 5 years.*
2. Improve accountability of waste disposal practices *by 1995.*
3. All new waste disposal sites and landfills to use only best available technology (BAT). *1994 and ongoing.*
4. Determine the extent of contamination with existing sites and implement plans to deal with the problem (i.e. collect and treat). *1995 and ongoing.*
5. Properly cap closed sites in order to minimize leachate *by 1995.*
6. Keep an up-to-date inventory of sites and site condition. *1994 and ongoing.*
7. Use only licensed/insured/bonded haulers. *1994 and ongoing.*
8. Sites will only accept waste they were designed to handle. *1993 and ongoing.*
9. Implement pollution prevention measures in order to minimize wastes. *Phase-in 5 years.*
10. Secure monies (bond) to avoid abandonments. *1993 and ongoing.*
11. Monitor site conditions and shallow groundwater zone to assess improvements. *1995 and ongoing.*
12. Ensure proper closing of all bore holes and wells. *1993 and ongoing.*
13. Mitigate and remediate contaminated groundwater.

**Ongoing domestic sanitary sources actions include:**

1. Identify problem areas.
2. Enable County Health departments to identify public health risks and report related diseases such that actions can be enforced.
3. Require home owners to either repair the existing system, construct a new system or require the municipality to investigate long-term solutions such as connection to the municipal sewer system.
4. Check and maintain septic tank systems.
5. Correct direct discharges of untreated sewage and "grey water".
6. Adopt and implement recommended changes to Ontario's Planning Act (December 1993) based on Sewell Commission recommendations (Appendix 5.2).



**Household Hazardous Waste**

**Ongoing household Hazardous waste educational actions include:**

1. Use less of the products.
2. Use reusable products such as rechargeable batteries.
3. Use substitute products that contain fewer or no toxic chemicals.
4. Proper use and disposal of household toxic wastes.
5. Proper disposal of non-toxic wastes.
6. Reuse non-biodegradable products.
7. Educate the public on the use and disposal of household hazardous materials and the use of alternative products.

**Other Initiatives**

1. Compost household organic wastes.
2. Control pets (feces).
3. Reduce atmospheric emissions (i.e. automobiles).

**C**ontaminated sediment may have contributed to 5 of 9 beneficial use impairments as follows:

- restrictions on fish consumption (mercury, PCB, dioxins, furans);
- chironomid mouthpart anomalies (through water and sediment contamination);
- degradation of benthos (through sediment contaminated with arsenic, mercury, cadmium, copper, chromium, iron, lead, nickel, zinc, oil and grease, PCBs, hexachlorobenzene and total PAHs);
- restrictions on dredging (total Kjeldahl nitrogen, total phosphorus, arsenic, mercury, cadmium, copper, chromium, iron, lead, nickel, zinc, manganese, oil and grease, PCBs, hexachlorobenzene and total PAHs); and
- added cost to agriculture or industry.

Contaminants in bottom sediments are derived from point and non-point sources.

In turn, elevated contaminant levels in bottom sediment act as a contaminant source through dissolution, resuspension and bioaccumulation. Parameters of concern in St. Clair River sediment are:

total Kjeldahl nitrogen, total phosphorus, arsenic, mercury, cadmium, copper, chromium, iron, lead, nickel, zinc, manganese, oil and grease, PCBs, hexachlorobenzene and total PAHs.

Results of bottom sediment surveys in the St. Clair River reveal the most heavily contaminated portion of the river, as identified by: most frequent exceedences of dredged material disposal guidelines; exceedences of the lowest effect level of the Provincial Sediment Quality Guidelines; and by sediment toxicity. This area is within 100 metres of the Ontario shore from the Cole Drain to downstream of Suncor.

The Sediment and Habitat Task Team developed a Sediment Work Plan that outlines actions undertaken by the team for the development of the Stage 2 RAP. A complete Sediment Work Plan is

provided in Appendix 3.2 and is summarized below. This work plan does not represent recommended actions resulting from task team deliberations. Recommendations (actions) are summarized at the end of this chapter. Work Plan components include:

- Agree to a uniform approach where international sampling protocols, sediment quality standards, sediment quality management, long and short term goals and decision making processes are defined;
- Identify impacted areas and characterize impact zones;
- Explore remedial technologies and compile information;
- Develop a sediment model and verify in the field;
- Prioritize areas for remediation;
- Implement remediation steps; and
- Develop monitoring and reporting systems.



## 6.1 Regulatory Programs

In Ontario there is no single specific policy for the management of contaminated sediments in circumstances other than those where dredging is proposed.

Sediment quality was initially assessed against contaminant concentrations established in the 1978 Revised Guidelines for Open Water Disposal of Dredged Spoils. Biologically based, Provincial Sediment Quality Guidelines (PSQG) have since been established for the protection of aquatic life. These guidelines address the significance of sediment contaminants in-situ.

In Michigan there are no biologically-based federal or state sediment quality standards, or guidelines for the identification of sediments that may be detrimental to aquatic life or to assess the severity of the effect. Regulations and guidelines are currently being formulated by the U.S. EPA and details are provided in Appendix 4.1.

## 6.2 Remedial and Prevention Measures and Actions in Progress

### 6.2.1 Remediation Approaches

A management strategy is being prepared to address the following items:

- identification and control of contaminant sources;
- delineation of type and extent of contamination (both concentration and total volume);
- evaluation of the potential for natural restoration;
- costs, funding and issuance of permits (for both removal and disposal);
- physical (i.e., depth, current, sediment types) and chemical (organics, metals) conditions of cleanup area relative to remediation options available; and
- pre- and post-cleanup monitoring for evaluation of effectiveness.

Each of these components is critical to the selection and successful implementation of a remedial action plan. However, of these, the identification and subsequent control of source loading is of most importance. Many of the remedial options available for contaminated sediments are very costly, and to undertake a cleanup program without the elimination or significant reduction at the source may prove to be a poor allocation of resources, as the sediments would only become contaminated again.

Having identified and put in place measures to control the sources of contaminants to the sediments, remediation may still be desirable for specific locations. There are a number of available remediation options/technologies which may be implemented through the establishment of a sediment management plan (Section 6.3).

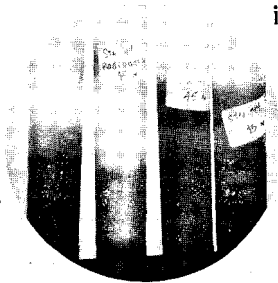
**Sediment remediation options/technologies include:**

**1. Natural Remediation (No Action):** This option uses only time for natural processes to reduce

environmental effects through decay, biological decomposition of contaminants or burial through normal sedimentation. This option requires monitoring in order to determine remediation rates and effectiveness. According to Wardlaw (1992) the "No Action" alternative must be evaluated at each site in order to provide a baseline for comparison to other options.

**2. Contain Sediment In Place (Capping):** The basic principle of capping is to place cleaner sediments over moderately polluted sediments. This method prevents contaminated sediment from interacting with aquatic organisms and the water column and prevents erosion of contaminated sediment particles.

Capping generally receives much opposition due to the disruption of the benthic environment and its ineffectiveness in severely polluted areas because gas production from the breakdown of organics under the cap can cause it to be lifted. In addition a cap is also subject to damage from ice flows and difficulty can be encountered during placement under high flow conditions.



**3. In-situ Treatment:** This treatment injects chemicals into contaminated sediment. The injection of nutrients can be used to stimulate the biodegradation of organics; chemicals can be added that convert contaminants to a less toxic form; or solidification/stabilization agents can be injected to reduce sediment and contaminant mobility.

This treatment is still considered unproven in that introduced chemicals to the sediment may have undetermined negative impacts.

**4. Sediment Removal (Dredging):** Dredging of sediments is undertaken for two purposes: maintenance for navigation, and removal of contaminated sediments. Three conventional dredging techniques (Bewtra et al., 1992) are available for sediment removal:

1. mechanical dredges remove sediments through the direct application of mechanical force to capture and remove;
2. hydraulic dredges use centrifugal pumps to remove sediments in a liquid slurry form; and
3. pneumatic or suction dredging is a subcategory of hydraulic dredges that uses entrained air or water instead of centrifugal force to remove sediments.

Dredged contaminated sediment can either be disposed of by placing it in a specially constructed "Confined Disposal Facility" (CDF) or by applying some sort of ex-situ treatment. Treatment means that some physical, chemical or biological process is applied to the sediment in order to reduce its toxicity or to reduce disposal costs. "Pre-treatment" is normally a physical process which de-waters, size separates, density separates or magnetically separates the sediment. The purpose of pre-treatment is to make the sediment easier to handle or to reduce the volume requiring treatment.

Many jurisdictions have placed restrictions on the quality of material that can be placed in confined disposal facilities (CDFs) and other disposal facilities.

This means that those responsible for dredging operations may have no means of disposing of the sediment. Recognizing this problem, several treatment options have been developed by Canada, the United States and Europe. Most sediment treatment options are described, evaluated and compared in the Beak (1993) "St. Clair River AOC Technical Options Study Report" (Part C, Section 3.8 in Appendix 4.3).

Advantages and disadvantages of removal and ex-situ treatment are outlined by Wardlaw (1992).

#### **Advantages include:**

- contaminants are removed permanently from the ecosystem and in some cases destroyed;

- necessary dredging can be performed that previously was prevented due to lack of disposal options;
- useful products may be recovered from the contaminated material; and
- public acceptance of this option has been excellent.

#### **Disadvantages include:**

- costs of this option are higher than most options although there is a wide variation in costs within this group of technologies;
- sediment removal may cause habitat destruction and resuspension of contaminated sediment in the water column;
- sediment removal technologies available at this time only remove up to 95% of the target material;
- treatment technologies may not be able to treat the material to a level clean enough for unrestricted disposal; and
- removal technologies have had limited testing/application in high flow situations like the St. Clair River.



### **▲ 6.2.2 Ongoing Programs**

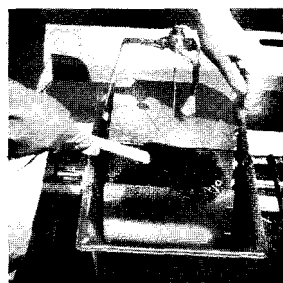
Although large scale contaminated sediment remediation projects have not been undertaken in the St. Clair River, concentrations of contaminants in sediments have generally been decreasing over the past 20 to 30 years (OMOE and MDNR 1991; and OMOEE and MDNR 1993). This decrease may be attributed to in-place initiatives by industrial dischargers. Significant reductions have been noted in concentrations of mercury, lead, oil and grease, and total PCBs generally as a result of changes in industrial processes, additional effluent treatment, improved housekeeping operations and spill prevention initiatives.

Dredging has taken place in the lower reaches of the St. Clair River in order to maintain the navigational channel and in Sarnia Harbour. In addition, vacuum

removal of perchlorethylene from the River bottom occurred in late 1985. Based on the Provincial Sediment Quality Guidelines (PSQG) which replaced the Open Water Disposal Guidelines in Ontario and the United States Environmental Association Dredge Disposal Guidelines in Michigan, most of the river's sediments are unsuitable for open water disposal and are placed in confined disposal facilities (CDFs). In Ontario a CDF is located on Seaway Island and operated by Transport Canada. In Michigan, contaminated sediments are disposed of in CDFs located on Dickinson Island. Although dredging occurred periodically in the St. Clair River AOC it should be noted that this activity was undertaken not as a remedial measure for RAP implementation but for navigational purposes. Heavily contaminated sediments are usually found within 100 metres of shoreline waters, not in open water channels.

### ■ 6.3 Ongoing RAP Activities

The St. Clair River Sediment Task Team and Sediment Subcommittee has developed a "Sediment Remediation Decision Tree" (Figure 6.1). This "Decision Tree" will be used to determine the most suitable option for contaminated sediment remediation in the St. Clair River.



#### **Characterize Impact Zones**

Results from the 1990 OMOEE sediment quality-benthic macroinvertebrate community assessment showed that, overall, sediment habitat conditions in the nearshore river environment had improved substantially since the previous surveys of 1985 and 1977. Nevertheless, in 1990 a number of areas of impaired sediment quality and benthic macroinvertebrate community structure were still present in the upper river, near the Ontario shore adjacent to the industrial facilities in and south of Sarnia to south of Stag Island. Sediments in these areas exceeded the Provincial Aquatic Sediment Quality 'Severe Effect Level' Guideline (PSQG) for one or more contaminants and in some cases there was

also evidence of benthic community degradation. These findings were also corroborated with laboratory sediment toxicity data for selected stations.

The Sediment Subcommittee used the 1990 OMOEE study results to characterize and prioritize the sediment impact zones. The process for determining these zones is as follows:

1. Review sediment chemistry to determine values in excess of PSQG lowest effect level (LEL) and/or severe effect level (SEL);
2. Correlate sediment chemistry data with statistical assessment of benthic community health; and
3. Establish priority areas 1 through 3 based on the following criteria:

- Priority 1 zones are characterized by SEL exceedences, degraded benthos and sediment toxicity.
- Priority 2 zones are less impacted with SEL exceedences, and impaired benthos.
- Priority 3 zones are identified with SEL exceedences.

As a result of this process three Priority 1, four Priority 2, and four Priority 3 sediment impact zones were identified (Figure 6.2). All impact zones are located in the upper St. Clair River nearshore to the industrial complexes in and south of Sarnia to south of Stag Island.

#### **Characterize Priority 1 Impact Zones**

In order that responsible and effective environmental management decisions can be made, the Priority 1 Impact zones must be adequately characterized with the view to assessing remedial options. A comprehensive zone characterization program was conducted by LIS and OMOEE during 1994/95. The objectives of this program included:

- Define the extent and severity of sediment contamination (inorganic and organic) in the Priority 1 Zone adjacent to Polysar and Dow in the

upper St. Clair River (OMOEE lead), as well as in the two additional Priority 1 Zones (adjacent to Suncor and to Dupont/Novacor/Ethyl - LIS lead) and correlate with the degree of benthic macroinvertebrate community impairment;

- Determine the toxicity of contaminated sediments to indigenous sediment-dwelling biota and to laboratory test organisms, and determine if sediment quality is still a limiting factor to improvement of the benthic macroinvertebrate community in the Priority 1 zone; and
- Determine if the sediment associated contaminants are available for accumulation by aquatic organisms in the field and in the laboratory.

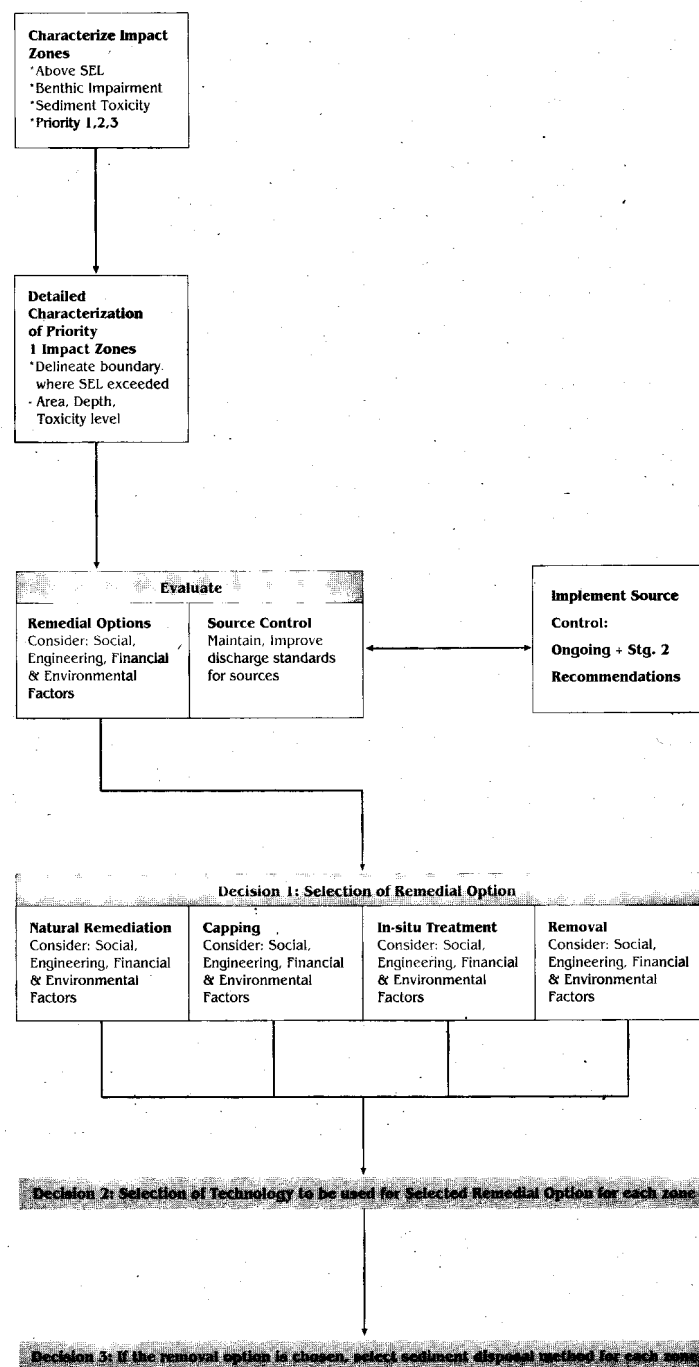
Results from these studies will be used to assist the RAP Implementation Committee in developing remedial measures for these contaminated sediments. In addition, survey results will be utilized by the Implementation Committee as a basis for remedial measure options for sediment and point source controls.

Due to resource limitations only one Priority 1 site was intensively studied during 1994/95 by OMOEE. LIS funded studies in all three Priority 1 Zones. At each site, samples were collected for both OMOEE and LIS analysis. A description of the OMOEE 1994/95 Sediment Impact Zone Characterization study is provided in Appendix 6.1.

Follow-up characterization programs will identify the following:

- conduct a resistivity seismic profile and evaluation of the priority impact zones in order to assess the physical character of the sediments;
- define differences in sediment quality within and between degraded zones;
- assess temporal changes within and between zones;
- analysis of non-routine parameters (e.g. polychlorinated styrenes, naphthalenes and

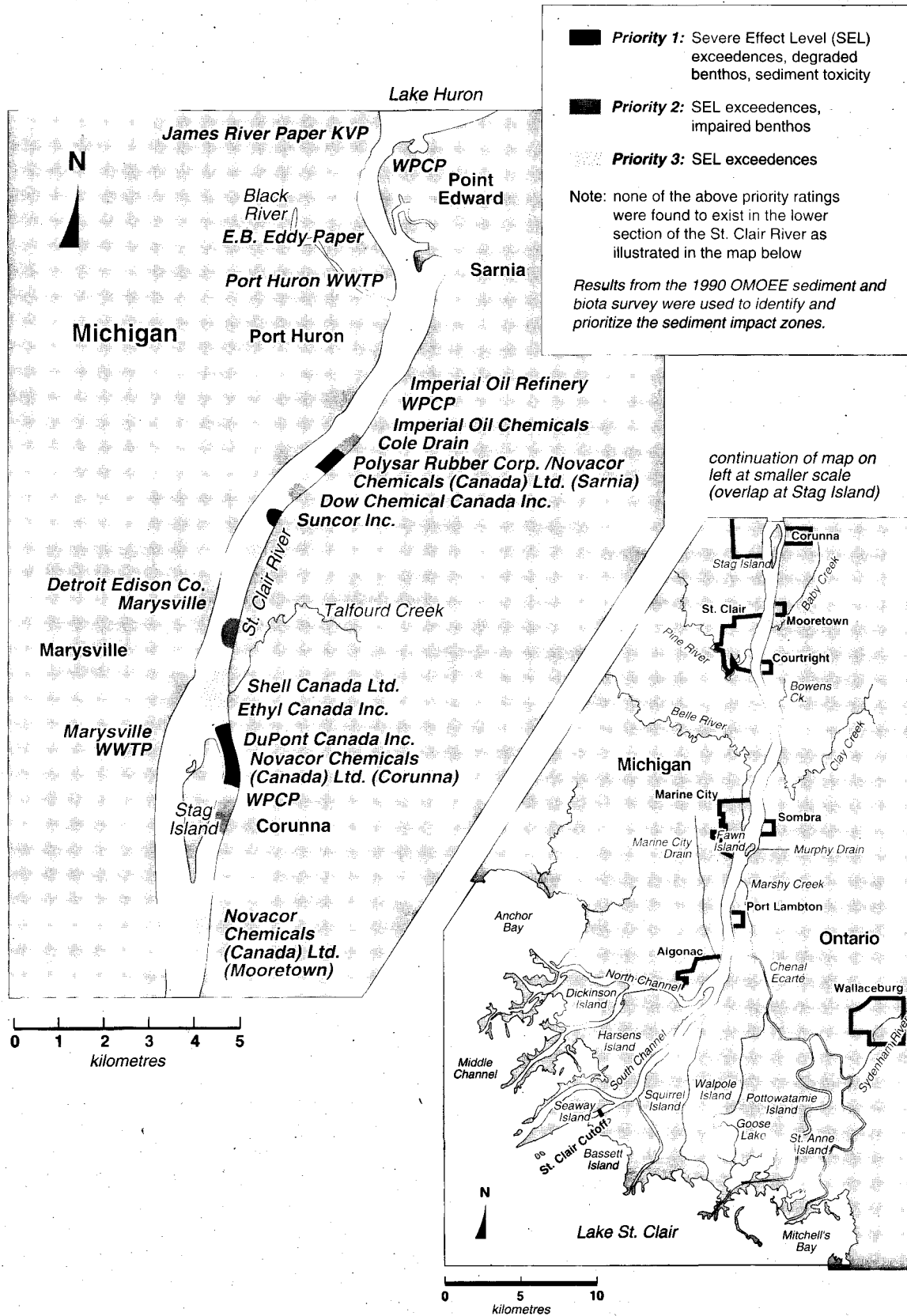
## Sediment Remediation Decision Tree



Diphenyl Ethers) in order to understand sediment chemistry kinetics; and

- conduct bench scale activities to assess the suitability of in-situ treatment options for chlorinated organic contaminants associated with St. Clair River AOC sediments.

# Location of sediment impact zones as defined by the RAP Sediment Task Team



## St. Clair Delta

Because of high levels of fish and wildlife consumption by First Nation residents, sediment on both the Ontario and Michigan sides of the St. Clair Delta needs to be assessed with respect to potential contamination and remediation.

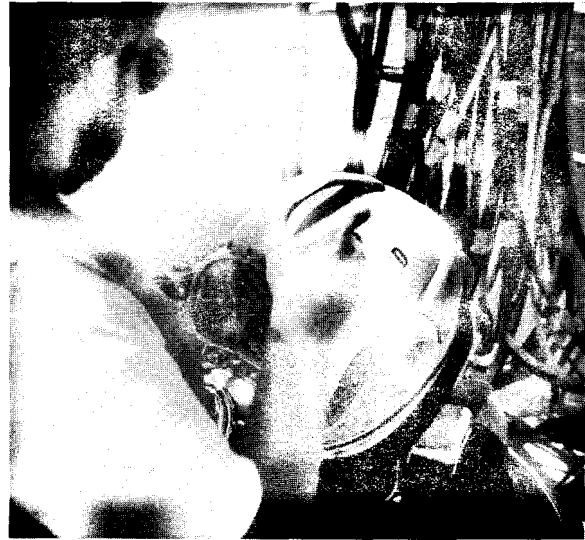
### 6.4 Actions

The following actions are to be completed in accordance with the principles and priorities as outlined in the implementation strategy described in Section 10.2. With respect to sediment remediation, it is premature at this time to recommend specific clean-up actions until completion of the ongoing sediment characterization studies. This comprehensive study was initiated in 1994 and it is hoped that within 2 to 3 years a detailed clean-up plan will be developed involving the RAP Implementation Committee, BPAC as well as responsible parties.



Actions for the remediation of contaminated sediment are as follows:

1. Ensure source controls are implemented.
2. Ensure the completion of the following programs:
  - 1994/95 OMOEE/LIS sediment characterization study;
  - 1995 Priority 1 Zones follow-on sediment characterization studies; and
  - 1995 review study of sediment transport mechanisms.



3. Undertake a complete assessment and evaluation of results from the above studies and projects including the rate of natural cleansing and the do-nothing option.
4. Based on assessment results from the sediment studies, develop pilot scale sediment remediation projects utilizing *in situ* sediment treatment and/or sediment removal and disposal. These projects should commence in 1996.
5. Evaluate the effectiveness of the remedial sediment pilot projects and develop a final sediment remediation strategy for the affected areas.



The Stage 1 RAP has identified "Loss of Habitat" as an impaired beneficial use in the St. Clair River AOC. Habitat loss is one of the most serious of the use impairments because it is the most difficult to reverse. Habitat loss and wetland degradation and loss, also affects four other use impairments which include:

- degradation of fish and wildlife populations;
- restrictions on fish and wildlife consumption;
- bird or animal deformities or reproductive problems; and
- degradation of benthos.

Fish populations have dramatically changed from earlier times but they are presently diverse and appear relatively stable and healthy; the populations are probably impaired to the degree that preferred littoral and wetland habitat continues to be lost and fish community goals, once available will be used to re-evaluate impairment status.

The Sediment and Habitat Task Team developed a Habitat Work Plan that outlines actions undertaken by the Sediment and Habitat Task Team for the development of the Stage 2 RAP.

A complete Habitat Work Plan is provided in Appendix 3.2 and is summarized below. This work plan does not represent recommended actions resulting from task team deliberations.

Recommendations (actions) are summarized at the end of this chapter. Work Plan components include:

- Establish baseline information, including:
  - compilation of historic and current wetland information into a GIS database for the St. Clair River AOC;
  - review and compile all land use information including zoning status;
  - review restoration techniques; and
  - review regulations;
- Develop specific long term goals and delisting criteria; and

- Protect, enhance and restore habitat.

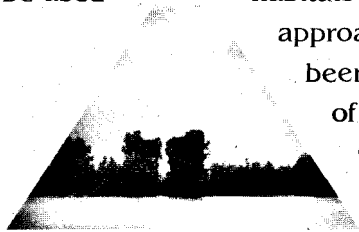
## ▲ 7.1 Habitat Protection

Numerous regulatory programs are in place for both Ontario and Michigan that can be used for the protection of wildlife habitat (described in detail in Appendix 4.1). With regard to Canada/U.S., the Boundary Waters Treaty establishes bilateral concerns relating to habitat protection. This treaty restricts activities relating to water levels, flow, and quality in one country that may cause harm to the other country.

### ▲ 7.1.1 Ontario and Canada

Regulations and their applicability to habitat protection are summarized below:

- *Fisheries Act*: protects aquatic and semi-aquatic habitats through a "no net loss" of fish habitat approach. Although a variety of guidelines have been prepared for the review and application of the Federal *Fisheries Act* in Ontario, a Great Lakes Guidance Document would provide further direction on review processes along connecting waters and Great Lakes shoreline areas. A variety of client groups have been requesting a clearer direction with respect to the development of shoreline areas and clearer direction on activities such as types of mitigation, and best management techniques.
- *Public Lands Act*: restricts activities on or adjacent to crown land and permits are reviewed by OMNR, OMOEE, Conservation Authorities, and Transport Canada. While good inter-agency cooperation/communication processes are being developed on an informal basis, these reviews could be improved through a more coordinated approach.
- *Endangered Species Act*: does not allow for the destruction or interference of an endangered species habitat in Ontario. However, due to limited endangered species habitats in the St. Clair River



AOC, this legislation has limited application at the present time.

- **Ontario Wetland Policy:** only relates to planning matters under the *Planning Act*. This policy does not provide protection for properties in or adjacent to provincially significant wetlands which already have all the prior planning approvals. Unless some other legislation - *Federal Fisheries Act*, *Public Lands Act*, or *Endangered Species Act* can be invoked, there are some cases where wetlands will not be protected.
- **Provincial Shorelands Management Policy:** will be available in draft form in the near future. All agencies involved in future and existing developments along shorelines will be required to manage shoreline related hazards (flooding, erosion, dynamic beaches) and all activities must demonstrate an understanding of their potential impacts on the shoreline environment or ecosystem and the mandates and objectives of other resource management programs (i.e. fisheries, wetlands wildlife).
- **Federal Policy on Wetland Conservation:** applies to the management of wetlands on Federal Lands such as Walpole Island, and is essentially a guide for wetland managers.
- **Navigable Waters Protection Act:** Although not designed to protect habitat, this act can be used to trigger the federal environmental assessment process which could result in changing proposed developments in order to protect fisheries habitat.
- **Beds of Navigable Waters Act:** Can be used to restrict alterations in water courses.
- **Conservation Authorities Act:** Flood and fill regulations promulgated under this act are used by Conservation Authorities to control or restrict development in the channel and flood plain. This act can be used as a powerful tool for the protection of existing wetlands and shoreline habitat.



## ■ 7.1.2 Michigan and the United States

- **Section 404, Clean Water Act:** requires a permit for the discharge of dredged or fill material to waters of the United States, including wetlands. Federal reviews are conducted for the following: major discharges of dredged or fill material; discharges into critical areas established under state or federal law (natural areas, wildlife refuges, historic sites); placement of fill which may impact the waters of another state; placement of fill material which contains known or suspected toxic pollutants or hazardous substances.
- **Michigan's Goemaere-Anderson Wetland Protection Act:** establishes regulations to preserve, manage, and protect wetland resources in the light of extensive historic losses and ongoing impacts due to human use and development. The MDNR may not issue a permit authorizing a loss of wetland unless certain stringent tests are met. The proposed project must be found to be in the public interest; must not unacceptably disrupt the state's aquatic resources; and impacts to wetlands must be unavoidable. The Wetland Protection Act applies to all wetlands in Michigan except for non-contiguous wetlands less than five acres (2 ha) in size, unless the MDNR determines that the particular wetland is essential to the preservation of the natural resources of the state. Although this act provides comprehensive protection of wetlands, most normal agricultural and silvicultural activities are exempted from permit requirements.
- **Michigan's Inland Lakes and Streams Act:** regulates construction activities below the Ordinary High Water Mark of inland lakes and streams. This act is used in combination with the *Wetland Protection Act* to regulate activities in wetlands.
- **Michigan's Great Lakes Submerged Lands Act:** provides for the protection of coastal wetlands below the ordinary high water mark of the Great

Lakes. Activities impacting on the remaining coastal wetlands are not allowed. Projects proposed in or near coastal wetlands are usually denied a permit unless the activity is necessary to exercise a riparian right of access, such as an open pile dock.

- **Michigan's Shoreland Protection and Management Act:** provides for the designation of Environmental Areas (EAs), defined as shoreland areas necessary for the preservation and maintenance of fish and wildlife.

- **Water Quality Standards for Wetlands:** are in draft form. Through the promulgation of wetland-specific water quality standards, wetlands will be included in the definition of "waters of the state". By this process, the quality and functions of wetlands will receive additional protection.

- **Michigan's Comprehensive Wetland Conservation Plan:** is currently under development and expected to be complete by the end of 1994. This plan will provide a mechanism for multi-agency involvement and input into wetlands management and protection.

- **Habitat Acquisition Programs:** Wetlands are purchased by MDNR through funds from the Michigan Natural Resources Trust Fund. MDNR also purchases development rights on lands identified as unique or critical to habitat preservation. Wetlands are sometimes also acquired through tax reversion.

## 7.2 Remedial and Prevention Measures and Actions in Progress

### 7.2.1 Remediation Approaches

Habitat degradation and loss has resulted from a multitude of human activities in the St. Clair River watershed. Remediation principals related to habitat protection, restoration and enhancement include:

- no further losses of current wildlife habitat;
- gain in wetland and aquatic habitat wherever and whenever possible;

- focus on areas of contiguous habitat, with a minimization of habitat fragmentation;
- provisions for diverse habitats and communities (i.e. an ecological approach); and
- high priority for endemic species, communities and habitats.

### 7.2.2 Habitat Restoration and Enhancement

#### Binational

In all habitat rehabilitation projects, an evaluation of impacts on water levels in the St. Clair River and elsewhere must be conducted. Under the Canada-U.S. Boundary Waters Treaty, Article III, activities which may impact the "natural level or flow of boundary waters on the other side of the line" shall not be carried out without appropriate federal

approval. RAP habitat enhancement activities involving the placement of fills, rock groins and breakwaters, artificial islands or other obstructions are subject to this approval. In this regard, ongoing discussions involving federal, provincial and state agencies are being conducted to assess the potential for problems before activities outlined on the following pages are carried out.

Habitat protection measures for waterfowl arising from the Detroit River RAP are evolving into a comprehensive habitat management plan for the entire St. Clair River - Lake St. Clair - Detroit River corridor. Developers of this plan include U.S. National Biological Service, Ontario Ministry of Natural Resources, Michigan Department of Natural Resources and several other environmental groups and government agencies.

The Michigan Department of Natural Resources (MDNR) Land and Water Management Division has created a GIS database for Michigan's coastal townships showing the location of all current wetlands, historic or presettlement wetlands, and land use/land cover information. A similar GIS



database is being compiled by Geomatics International for the Ontario St. Clair River watershed. During data evaluation and restoration planning, current and presettlement wetlands will be compared for the entire watershed in an attempt to identify areas feasible for restoration.

Under the auspices of the North American Waterfowl Management Plan, the Eastern Habitat joint venture was formed to protect and enhance waterfowl habitat in the Great Lakes watershed. Organizations active in habitat protection, restoration and securement in the St. Clair River watershed include: OMNR, MDNR; Canadian Wildlife Service, Nature Conservancy of Canada Waterfowl USA, Michigan Duck Hunters Association and Ducks Unlimited.

Ducks Unlimited also work with private land owners in water management practices in order to preserve wetland habitat. In some instances, wetland habitat is acquired or agreements secured with land owners.

#### **Ontario and Canada**

The Chatham Ministry of Natural Resources office has prepared a document entitled *Survey of*

*Candidate Sites on the St. Clair and Detroit Rivers for Potential Habitat Rehabilitation/Enhancement*

(Figure 7.1). This candidate site report (OMNR 1994) evaluates and prioritizes areas based on a complex scheme involving cost/benefits; design; partnerships and sustainability as well as a number of other critical factors. It also provides a comprehensive evaluation of technologies and feasibility for specific remedial actions at Candidate Sites. Perhaps the single most important factor lies in "opportunities" that present themselves either through concerted efforts to gain interest from land owners and potential partners or unsolicited interest. As a consequence, priorities may be altered to reflect "opportunities" which offer a more streamlined means to move towards RAP goals and objectives.

Habitat enhancement and rehabilitation projects on candidate sites (Figure 7.1) on the St. Clair River and Chenal Ecarté that could potentially be completed by OMNR by the year 2000 include:

- Chenal Ecarté Wetland Creation (155 ha) (384 acres)
- Stag Island (80 ha) (198 acres)
- Darcy McKeough Floodway (445 ha) (1100 acres)

#### **Walpole Island**

The Ontario Ministry of Natural Resources Chatham office and the Walpole Island Heritage Centre are planning discussions with regard to cooperative ventures relating to the identification of candidate rehabilitation sites on Walpole Island. Habitat restoration in the Walpole Island First Nation Territory is not as immediate a need as elsewhere in the AOC as much of its wildlife habitat has been maintained.

#### **Stag Island Habitat Restoration Project**

A proposal for habitat creation and rehabilitation on Stag Island has been submitted to the Great Lakes Cleanup Fund (GLCUF). Because of its location in the highly industrialized, upper reach of the St. Clair River, Stag

Island is the only location in this part of the river where a significant wetland can be created. Historically, Stag Island supported a large vegetated wetland that was infilled with dredged material hence eliminating fish spawning and nursery as well as wetland habitat.

The objectives of the rehabilitation plan are:

- (1) Enhance existing wetland for fish and wildlife production; and
- (2) re-create as much wetland as possible by creating calm water areas within the shallow waters of the west side of the island. Work will be conducted over a three year period. First year funding requested from GLCUF totals \$180,000.00. Additional sources of funding are currently being investigated.



### **Centre By The Bay Point Lands Development**

The objective of this project is to create experimental wetlands and forests together with educational facilities on a spit located adjacent to the marina in Sarnia Bay. Proposed habitats would include wetlands, carolinian and boreal forest zones, and prairie wild flower habitat. An education centre, emphasizing the importance of the great lakes ecosystem and the role of the St. Clair River RAP would also be established.

This development is being promoted by the Futures Committee of Centre By The Bay, a local organization that promotes environmental awareness and entertainment. They have hired a landscape architect to design the development. The Futures Committee have acquired approval from the Sarnia City Council and St. Clair Parkway Commission to use (not own) the land and have received approval for their proposal from Sarnia City Council. Implementation is now partially underway and sources of funding are being sought. Provincial agencies, through the RAP process, will provide technical assistance for forestry and wetland development.

### **Chenal Ecarté Wetland Creation**

A proposal for wetland creation along the Chenal Ecarté area in Dover and Sombra Townships has received start-up funding support from the Great Lakes Clean-Up Fund in 1993 and is expected to receive additional funding in the coming year. This project will create marsh habitats at selected sites along this 29 kilometre channel. One of the main habitat impacts identified in the Stage 1 report was loss of habitat due to drainage for agriculture and urbanization. Dyke breaching and the creation of marsh areas through both water level control and natural lake level fluctuations will be the primary habitat creation focus in this proposal.

### **Darcy McKeough Floodway**

A floodway channel designed and constructed in the late 1970s to serve as a flood diversion channel for

the Sydenham River is being investigated for possible opportunities for habitat improvements. Small scale wetland areas, native grass plantings, and pond excavations are some of the potential habitat ideas being reviewed. These will have to be closely examined in regards to original design specifications of the diversion channel and potential impacts of hydraulic function.

### **Big Point Habitat Restoration Project**

The Big Point wetland complex is located on the east shore of Lake St. Clair immediately south of Mitchell's Bay. This wetland complex, recognized as one of the most productive fish and wildlife habitat areas in southern Ontario, was not included in the St. Clair River AOC. Because the Chatham Ministry of Natural Resources has proposed work within the AOC

in Mitchell's Bay, which is considered part of the Big Point wetland complex, habitat rehabilitation to the remainder of the complex south of Big Point will contribute to the overall health of the ecosystem.

High water levels in the 1970s and 1980s drowned most of the emergent vegetation. Landward agricultural dykes prevented natural marsh recolonization

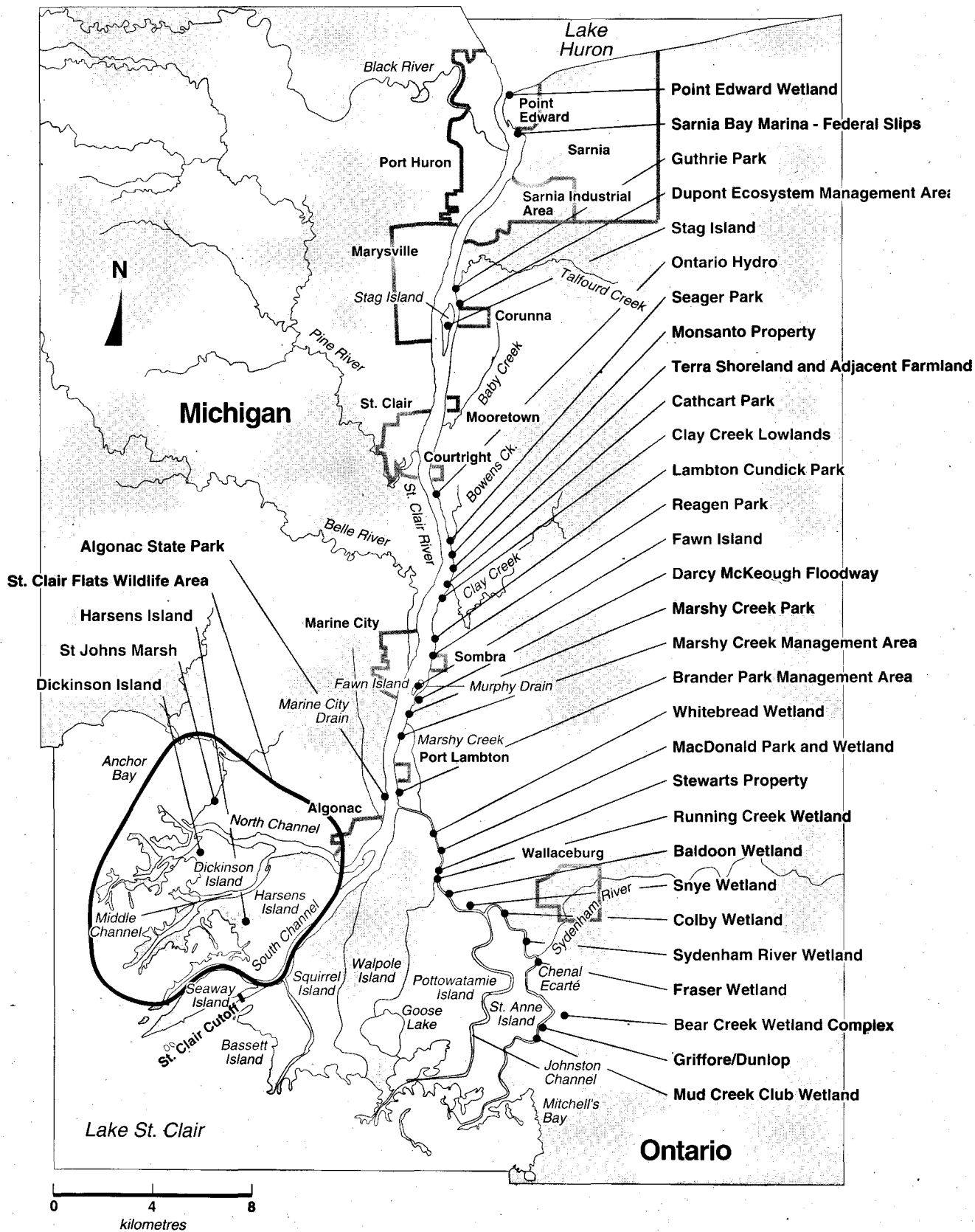
on higher ground during high water periods. Water levels have since decreased however, most of the marsh biota has been destroyed. The Canadian Wildlife Service, Ontario Region obtained funding from the Great Lakes Cleanup Fund (GLCUF) for proposal and project development, partner identification, and concept development. They have since established a partnership with Ducks Unlimited and have done some field work i.e. collecting information on sediment composition, vegetation, wave action, sediment disruption and shore hardening. This information was subsequently used to develop site specific rehabilitation plans.

A follow-up proposal has been submitted to GLCUF for conducting experimental revegetation in selected test areas within the Big Point marsh



# Candidate Sites Within the St. Clair River AOC for Potential Habitat Rehabilitation/Enhancement

(OMNR 1994; MNHR 1994)



complex. Additional sources of funding are also being investigated. Structural replacement or partial re-establishment of the barrier that once protected the Big Point marsh complex has been proposed to be investigated in 1995/96. Options for the prevention of future high water levels have yet to be identified.

#### **Agriculture Green Plan**

In Ontario, ten wildlife habitat sites have been selected for detailed study. The project is administered by the Canadian Wildlife Service. Although none of the ten sites are located within the St. Clair River watershed, study results will be applicable to management of the watershed's wildlife habitat.

#### **Land Stewardship**

The land stewardship program was initiated by the Natural Heritage League (NHL) for the protection of carolinian forest areas in southwest Ontario. Land stewardship is now practised by OMNR for the protection of wetland habitat. Areas that need to be protected are first identified. Landowners are contacted and verbal agreements are made between the land owner and OMNR or NHL for the protection of habitat and or the watershed. If environmental problems are found to be present, agencies will financially assist the land owner in remediation through a variety of funding programs (i.e. CURB).

#### **St. Clair/Sydenham River Regional Habitat Management Plan**

The St. Clair/Sydenham River Regional Habitat Management Plan is a multi-year fish and wildlife habitat creation/enhancement strategy designed to increase populations and expand upon the internationally significant habitat that exists in the area. This plan recognizes the importance of agriculture, wetlands, woodlands and grasslands and the intrinsic role each plays in wildlife habitat management. A landscape approach has been adopted for the plan that will lead to the linkage of

small habitat parcels thereby enhancing the ecosystem. Proposed projects will manage wetland, upland and riparian habitats, as well as outline environmentally friendly alternatives to current agricultural practices. This plan is a multi-year initiative and submissions to funding partners will be ongoing.

#### **Michigan and the United States**

##### **STATE LAND:**

##### **Algonac State Park**

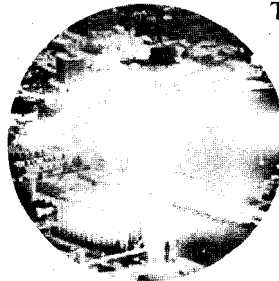
A management plan for Algonac State Park and lakeplain prairie restoration is being undertaken by the Natural Heritage Program in MDNR's Wildlife Division, with funding assistance from the Coastal Management Program.

##### **St. Clair Flats Wildlife Area**

The islands, marshes, bays and channels at the mouth of the St. Clair River are collectively known as St. Clair Flats. Much of Dickinson Island, Harsens Island, St. Johns Marsh, the adjacent marshes and bays are in public ownership. State managed wildlife areas are located on Harsens Island and at St. Johns Marsh.

A portion of a U.S. Fish and Wildlife Service grant, administered by the MDNR Land and Water Management Division, has been set aside for wetlands restoration in the Flats area. The estimated cost for removal of old seawalls and dilapidated structures is \$20,000 (U.S) for two lots that have reverted back to state ownership.

In April 1981, Michigan's Natural Resources Commission approved the St. Clair Flats Management Plan developed by the MDNR. This plan covers the platted lots south and west of the main portion of Harsens Island and recommends that MDNR acquire submerged, undeveloped leased lots whenever possible through reversion to the State for non-payment of taxes or by offering of the lot as a gift to



the State. Approximately 25 residential lots have reverted back to the state in the last several years.

Seawall installation, dredging, filling and other construction permit applications are reviewed carefully to minimize adverse impacts to wetlands, bottom lands, open water areas etc. The Plan also indicates that the State shall not lease or deed existing unleased State owned property as most of these parcels are submerged or are undeveloped marsh. When a deed is issued for a parcel, only the existing "upland" area of the lot is included in the legal description. The balance of the lot that is generally submerged and/or marsh is retained by the State.

### **Dickinson Island**

Dickinson Island, at the heart of the St. Clair Flats Wildlife Area, represents a major portion of the remaining coastal wetland habitat in the U.S. Lake St. Clair. This area remains as one of the largest natural undeveloped and functioning wetland complexes along Lake St. Clair, and is an important biological study area. Wildlife management practices are limited to periodic controlled burns and placement of nesting structures. Special concern, rare and endangered species and habitats have been identified. A Great Blue Heron rookery is located on the island.

### **Harsens Island**

An updated management plan for Harsens Island is being drafted. Some minor work is being done on existing state land; habitat changes proposed at Harsens Island include enhancing 73 acres (30 ha) for waterfowl nesting and brood rearing by construction of small ponds and nesting islands. Agricultural units and U.S. Army Corps disposal sites have been converted to wet meadows and emergent marsh habitat. Future work includes development of small ponds, meadows and nesting islands. Improved access is also proposed by elimination of some dike pullovers and level ditching to allow

hunters to float their boats to hunting areas. This will also improve fish access to critical habitat.

New land acquisition (approximately 400 acres (162 ha)) has been proposed; much of the site is wetland and is being offered to the state following permit denial for a very large marina development. This parcel has been nominated for funding through the Land Trust Fund. There is a question of who will manage the site as there are several buildings that were used as dorms. The suggested use is for an environmental education center.

### **St. Johns Marsh Wildlife Area**

Currently, the area encompasses approximately 2,300 acres (931 ha), and is being managed to increase biodiversity. Because of the areas size and diversity of habitat, wildlife development and maintenance activity is directed towards preserving, protecting and enhancing existing marsh and upland habitats to meet the needs of breeding and migratory waterfowl, and other wildlife species. Practices for managed areas include: dyking for water level management, establishment of waterfowl production areas (including creation of approximately 15 acres (6 ha) of wetlands), controlled burns, mechanical and chemical control of purple loosestrife and brush, artificial nest structure placement, and maintenance and preservation of prairie habitat. Michigan Department of Transportation mitigation site will add to existing habitat; the plan has not been finalized. A management plan for St. Johns Marsh is in draft form and the interested parties are working out a plan that will increase wetland area while avoiding flooding of existing lakeplain prairie, a rare natural habitat.

### **FEDERAL PROGRAMS FOR PRIVATE LAND:**

Agricultural landowners interested in participating in the conservation reserve program may contact the U.S. Natural Resource Conservation Service (Soil Conservation Service). An NRCS representative may

then conduct a site visit to determine, with the property owner, the most appropriate conservation scheme for the property. A management plan is subsequently developed for the property in order to achieve the goals of the landowner. Wetland restoration projects are turned over to the U.S. Fish and Wildlife Service.

The conservation reserve program, administered by NRCS, takes agricultural land out of production for 10 years. The landowner is paid an amount/acre each year. These lands provide habitat for many species. Over 300,000 acres (121,410 ha) have been enrolled in this program state wide. At the present time, 1,780 acres (720 ha) have been enrolled in the program in St. Clair County. Most of the enrollment took place in 1992 and 1993, with 10-year agreements. At this time, the renewal of the program is in question, as it is considered a subsidy subject to budget cuts.

The agricultural conservation program takes agricultural land out of production on an annual basis.

A wetland reserve program has been proposed. If approved, wetlands on agricultural land would be taken out of production to be restored. The U.S. Fish and Wildlife Service, Ducks Unlimited, or other groups, could pay for restoration. The landowner would enter into a perpetual easement to maintain the wetlands in restored condition.

#### **FEDERAL PROGRAMS FOR PUBLIC OR PRIVATE LAND:**

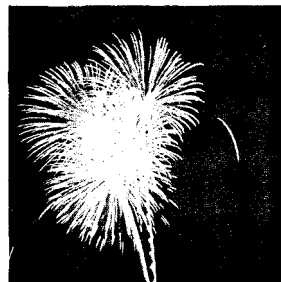
The North American Waterfowl Management Plan encourages partnerships between agencies. The St. Clair River and delta are part of a priority area for the Plan.

#### **PRIVATE PROGRAMS:**

The Michigan Wildlife Habitat Foundation (MWHF) has an aggressive wetland restoration program. This

group has applied for funding through the North American Waterfowl Management Plan. If received, this grant will allow the MWHF to substantially increase their efforts state wide. This group has worked with State agencies in the past to restore wetlands.

The Nature Conservancy has studied the St. Clair Flats area extensively and continues to work to formulate conservation easements, management plans, and agreements with property owners and land managers for restoring and protecting significant natural communities. The Nature Conservancy's Great Lakes Office in Chicago, Illinois, has worked with The Nature Conservancy of Canada towards the protection and restoration of natural communities in the Great Lakes basin.



## **7.3 Actions**

### **Sources of Funding**

State Policy in Michigan places emphasis on wetland protection and acquisition in Lake St. Clair and Lake Erie. The Michigan Department of Natural Resources (MDNR) Wildlife Division is developing a catalogue of funding sources for wetland restoration

work. The OMNR Chatham office is currently exploring funding mechanisms for restoration of habitat in Ontario; possible funding sources which have been identified include the GLCUF and the North American Waterfowl Management Plan (NAWMP). Land owner cooperative programs are also being investigated.

### **Ongoing Actions**

Ongoing actions pertaining to habitat protection, restoration and enhancement are itemized into three categories:

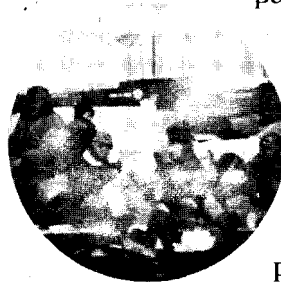
- Protection;
- Rehabilitation and Enhancement; and
- Education and Communication.



The following actions are to be completed in accordance with the principles and priorities outlined in the implementation strategy described in Section 10.2.

#### **Education and Communication Actions:**

1. Develop and implement a strong comprehensive education and communications program to deal with habitat issues (e.g. draft "St. Clair RAP Communication of Protection and Enhancement Measures for Wildlife Habitat"). Responsible party: RAP Implementation Committee.
2. Develop detailed habitat/aquatic guidelines outlining regulatory requirements, review procedures, and best management techniques to assist landowners, developers, consultants and municipalities. Educate municipal, county and township officials on regulations affecting habitat (e.g. workshops). Develop mechanism of coordination of agencies responsible for disseminating information and enforcing regulations. MDNR Land & Water Management Division programs may serve as a model for RAP programs. Responsible party: St. Clair River RAP Implementation Committee.
3. Public education programs will include information programs (i.e. Sea Grant, Great Lakes Fisheries Commission) which attempt to prevent further spread of exotic species.



#### **Actions for Habitat Protection:**

1. Strengthen wetland protection regulations in Ontario, to provide specific regulatory authority for protection of all types of wetlands, and provide penalties for violators. Strengthen wetland protection in Michigan through application of voluntary and regulatory programs that address silvicultural and agricultural activities currently exempted from wetland permitting requirements. Responsible parties: Ontario and Michigan legislative bodies (with lobbying by many parties).
2. Reduce ship wakes and surges. Responsible parties: U.S. Coast Guard and Canadian Coast Guard.
3. Minimize shoreline and benthic habitat damage attributable to winter shipping. Responsible parties: MDNR, U.S. Corps of Engineers, U.S. Coast Guard, U.S. Fish and Wildlife Service, Canadian Coast Guard.
4. Control shoreline erosion to improve benthic habitat. Responsible parties: MDNR Surface Water Quality Division Non-point Source Program; USDA Natural Resource Conservation Service (Soil Conservation Service).
5. Contact landowners for "candidate sites" and other sites about proposed habitat protection and enhancement activities. Responsible parties: OMNR, Lambton Wildlife, The Nature Conservancy.
6. Work with the Walpole Island Heritage Centre and First Nation peoples to identify candidate sites on the St. Clair Delta. Responsible party: OMNR
7. Integrate shoreline erosion, shoreline development (or redevelopment) projects with environmentally friendly habitat approaches (like buffer strips and spawning channels) that take hydraulic impacts into account. Improved inter-agency communications and the need to be

proactive and opportunistic is key to this approach. Responsible parties: all agencies.

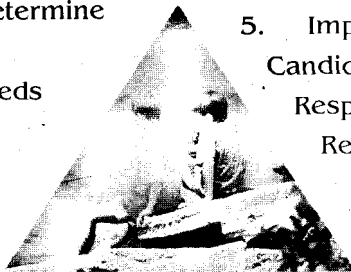
8. Recognize the St. Clair AOC as a priority area within each agency to increase enforcement focus. This could be a combination of increased funding, focused training for aquatic habitat protection, or a shift in enforcement focus (geographically). Responsible parties: OMOEE, OMNR, MDNR.
9. Encourage conservation easements as a mechanism for habitat protection.
10. Impose strict regulations on use of small watercraft i.e. wave runners etc. within shallow water marshes of the St. Clair River Delta for habitat protection.
11. Complete a GAP Analysis in order to determine the difference between habitat that is currently protected and habitat that needs to be protected in order to maintain wildlife diversity and integrity.

#### **Actions for Habitat Rehabilitation and Enhancement:**

1. Pursue Stag Island restoration. Responsible party: Ontario Ministry of Natural Resources.
2. Maximize fish use of wetland areas in the Delta; provide fish access to wetlands. Responsible party: Michigan Department of Natural Resources Fisheries Division.



3. Develop compatible mapping data base between U.S. and Canada areas of concern. Responsible parties: Michigan Department of Natural Resources, Ontario Ministry of Environment and Energy.
4. Encourage maintenance or restoration of riparian vegetated zones. However, where this vegetation has already been removed, and cannot be restored, use rip-rap instead of seawalls, or a combination of rip-rap and seawalls to mitigate the effects of ship wakes, enhance fish habitat, and increase shore stabilization. Where seawalls are already installed, place rip-rap at the base of the walls. Replace old seawalls with rip-rap. Responsible parties: MDNR Land and Water Management Division, Fisheries Division; OMNR; RAP Implementation Committee education programs.



5. Implement projects identified in OMNR Candidate Sites Report as opportunities arise. Responsible party: Ontario Ministry of Natural Resources.

6. Integrate concepts and techniques of 1994 OMNR Candidate Sites Report where possible in other areas of the St. Clair AOC which were not specifically identified in this report.

7. Expand candidate sites inland in Ontario. Develop a "candidate sites" list for wetland and aquatic habitat restoration projects in the Michigan portion of the AOC, similar to that developed for Ontario. Responsible parties: OMNR, MDNR, U.S.FWS, U.S. National Biological Service, Nature Conservancy Great Lakes Program.
8. Acquire proposed Harsens Island Land. Responsible party: MDNR.
9. Explore opportunities for joint projects between all of the agencies within the AOC, for restoration of wetland and aquatic habitat. Compare lists of special status species for the AOC, and set

priorities for habitat restoration based on those species that: 1) have binational special status, 2) historically occur or potentially could occur in the AOC, 3) depend on aquatic and/or wetland habitat, and 4) have decreased populations due to habitat destruction or degradation.

Responsible parties: RAP Implementation Committee, MDNR, OMNR, OMOEE.

10. Include invertebrates, plants, unique plant communities and other special features in addition to mammals, birds, fish, reptiles and amphibians in the "special status species" lists. Special features would include, but are not limited to: Great Lakes Marsh, Lake Plain Prairie, Southern Swamp, Great Blue Heron Rookery. Responsible party: RAP Implementation Committee.

11. A long-term habitat management plan for both Michigan and Ontario, including an assessment of needs relating to wildlife diversity and integrity will be completed.  
Responsible Parties: MDNR, OMNR, USFWS, NBS, Environment Canada.



#### **Actions Related to Exotic Species:**

1. Where habitat is being restored, enhanced, or in any way altered, care will be taken to avoid the creation of "incidental" habitat favourable to exotic species.
2. Control mechanisms for exotics in the AOC will take into consideration water quality objectives. For example, physical or biological controls for zebra mussels may be preferable to chlorination of intakes, or dechlorination must occur before discharge, since chlorine is a contaminant of concern.
3. The RAP will consider future local endorsement and implementation of control measures for exotics if and when they become feasible.

**P**ublic involvement and education activities during Stage 2 have been undertaken through the Common Issues Task Team and the Communication Subcommittee of BPAC. Activities undertaken or planned include:

- develop and implement an environmental education program for local schools;
- increase public awareness of the RAP, its Goals and Objectives;
- develop and implement educational programs for the general public; and
- encourage and enhance public involvement in all phases of RAP implementation.

## 8.1 Summary of Recent and Ongoing Outreach Programs

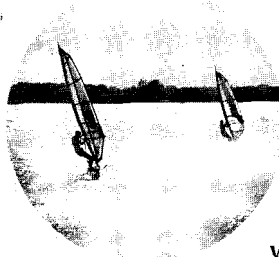
Youth involvement in the RAP has been obtained through working with various local youth groups. The St. Clair River RAP environmental education program was designed to transfer up-to-date RAP information to teachers and students and provide a basis for understanding the local environment, each person's responsibilities, and actions to improve the river's quality. It was also designed to help instill an environmental ethic. The program was developed involving grades 7 and 8 students in Wallaceburg and Port Huron. The intent is to prepare formal "Units of Study" to complement existing curriculum with ready-to-use activities and materials for all grade levels and all subject areas.

Eco-friends is a pen pal program established between U.S. and Canadian schools throughout the St. Clair River communities. One school twinning project is currently underway and others are planned. It is hoped that communications between twinned schools can be established using modems.

Bus tours involving BPAC and RAP Team volunteers to discuss the St. Clair River and provide tours of local facilities have been established. The program is

referred to as the Student International Tour for the Environment (SITE). Two tours were held in 1993 involving four different schools in the U.S. and Canada. Students included elementary and high school levels representing both public and catholic school boards.

The Interactive Learning Centre (ILC) is a computer program which requires a participant to interact with a series of questions on the St. Clair River. The program featuring "Professor Trout", has general and advanced levels of questions from three subject categories: living things, water quality, and physical properties. The ILC has been positively received by a variety of users at community events and schools. Teachers claim that it is a highly effective way to teach students. The ILC includes the computer software and hardware housed within a self-contained unit. It is currently touring local schools in Canada and the U.S.



The BPAC created "St. Clair River Week" in 1992 which has been growing in popularity each year since. The purpose of the event is to draw public attention to river water quality, the work of RAP, and individual responsibilities in environmental protection and cleanup. A variety of events including theatrical workshops, folk music festivals, underwater dive demonstrations, plant tours, art displays, and much more have proved very successful. In 1994, the River Week event was combined with the annual Envirofest which is based on community partnerships.

A photo contest to help celebrate the St. Clair River has been held annually since 1992. Prizes totalling \$4,000 to \$5,000 (\$Can) are awarded. Between 350 and 400 photos are received from amateur photographers and each is displayed for public viewing. The public votes for its favourite photos. The contest has proven valuable in its ability to inform people about the RAP.

Local Girl Guides participated in Trout Unlimited's Storm Drain Marking Program (SDMP) in Canada

during the 1993 River Week. Girl Scouts and students in Port Huron participated in a separate SDMP held later in the same year. Girl Guides again conducted the Storm Drain Marking Program during St. Clair River week, 1994.

Local Girl Guides are planning a habitat enhancing project through the OMNR on Stag Island. The project includes construction and placement of duck boxes, swan platforms, and swallow nests. A return visit is to be made by the girls in the following year to count the hatch. Plans include eventually expanding the youth involvement to Boy Scouts, schools and other youth groups.

Beginning in 1993, the BPAC developed a special award referred to as the Environmental Achievement Recognition Program. The award is designed to recognize and encourage activities to improve the local environment. In 1993, 14 nominations were put forward and a total of 6 awards presented to a mix of individuals, groups and facilities. Nine nominations were made in 1994 with three awards being presented.

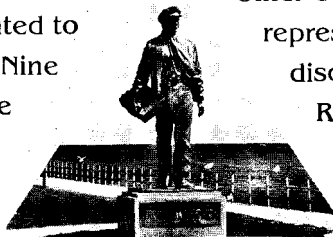
A 1994 St. Clair River Week logo contest was held among high school and college art design and marketing students in the St. Clair River area. The winning logo, chosen from among 35 entries, is being used on promotional materials for St. Clair River Week.

The Waste Reduction Institute for Training and Applications Research (WRITAR) worked with the Great Lakes Pollution Prevention Centre and OMOEE to assist metal fabricators in implementing pollution prevention options. Two metal fabricating facilities participated in the project and assisted in holding an educational workshop designed to encourage similar facilities to implement pollution prevention measures. The goal of the project was to educate small and medium sized businesses and reduce metal loadings to the Sarnia WPCP.

A wide variety of other events have been conducted in support of outreach and education. These include river cruises hosted by BPAC and RAP Team members, media briefings and releases, development of posters and calendars, preparation of newsletters and three videos and several speaking engagements. Planned programs include: continuing to expand existing programs (i.e. River Week gets bigger every year and more students become involved in the education program at schools and through youth groups), community workshops exploring RAP, and the Point Lands Development Project.

The Ontario Public Advisory Council and the Michigan Statewide Public Advisory Council participated in a special conference in the Sarnia/Port Huron area during September 1994. This conference was hosted by the St. Clair River BPAC. Specific workshops and other events were organized to allow representatives the opportunity to meet and discuss shared concerns and issues. Various RAP coordinators also attended.

BPAC has also been involved in additional activities which include: participation at the Centre by the Bay's annual beach clean up since 1992; attendance at community events such as Envirofest since 1988 and Festival by the Bay since 1990; development of the pamphlet and activity book with MDNR; writing of news articles that are





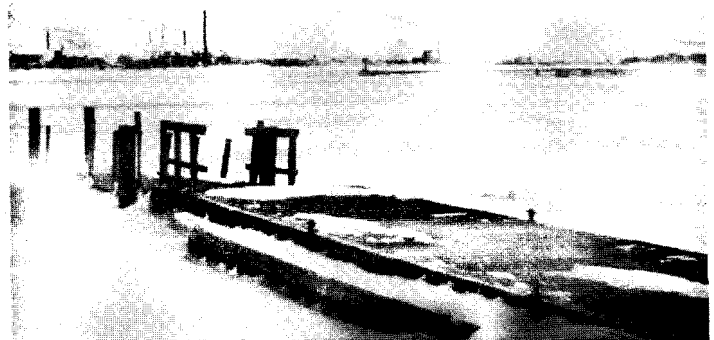
published in local papers from Sarnia to Wallaceburg; and preparation of a display booth that tours local communities throughout the year.

## ▲ 8.2 Actions

1. Develop and implement a public involvement program specific to the implementation of the St. Clair River Remedial Action Plan. This program should both inform and involve the public regarding progress in achieving Water Use Goals and Objectives as well as delisting of beneficial use impairments.
- 2 Fully develop and implement all necessary public information and education activities to facilitate RAP implementation as identified by the various task teams, including:
  - providing information on progress toward loadings reductions and implementation of other programs to reduce/eliminate pollution from point sources;
  - assisting governments to educate small businesses and other toxics users and producers on pollution prevention/reduction;
  - developing information/education programs in co-operation with other RAPs and existing agency programs regarding measures to

- reduce/eliminate contamination of urban and rural runoff;
- developing information/education programs in co-operation with local municipalities to reduce/eliminate use and improper disposal of household hazardous wastes;
- providing information on results of sediment characterization studies and encourage public involvement/interest in pilot-scale sediment remediation activities;
- developing and implementing a strong comprehensive education and communications program to deal with habitat issues;
- developing programs to educate landowners, developers, consultants and municipalities (including county and township officials) on regulations affecting habitat;
- encouraging coordination among agencies responsible for disseminating information and enforcing regulations regarding habitat.

3. Continue and further enhance the various public outreach projects already initiated throughout the implementation stage of the RAP.



## 9.1 Determination of Monitoring and Research Needs

**M**onitoring to determine progress towards meeting the RAP goals and objectives as well as research to further evaluate those use impairments which have not been adequately assessed (Table 2.1) are essential components to the implementation of the RAP. Many on-going monitoring programs are being undertaken by government agencies and by industry. In some cases existing programs will be sufficient to meet the requirements of the RAP, whereas, some programs may require adjustments to sampling locations, frequency of sampling, and parameters to be measured/estimated. Twenty two of the existing monitoring programs were described in the St. Clair River Stage 1 Addendum Report and will not be repeated in this document.

In addition to the expertise and resources available through government and private sector monitoring and research activities, the RAP will where possible utilize the resources and expertise available locally (e.g. Community Colleges). Of particular benefit to the RAP will be those programs responsible for training students in the fields of resource management, environmental technology and engineering.

Monitoring and research issues were also discussed at a one day workshop held in March 1994. It was attended by RAP Team and BPAC members as well as several monitoring experts from federal, provincial, and state governments and from industry. The workshop allowed for consideration of the following in the development of detailed monitoring and research workplans:

- determine which monitoring and research needs can be met simultaneously with comprehensive studies, and how;
- determine who is best suited to conduct certain studies either independently or cooperatively;

- ensure that redundancy is eliminated and gaps are filled;
- set priorities with the recognition that resources are limited; and
- determine how we can design studies so that they will fulfil our needs, but may also serve as a useful basis for applications elsewhere.

Several monitoring and assessment programs are being carried out or planned in the St. Clair River AOC to evaluate the effectiveness of ongoing remedial actions. These monitoring studies will provide the primary evidence to determine if and when an impaired use can be delisted or if further remedial action is required.

## 9.2 Monitoring Programs For Impairments to Beneficial Use Categories



Existing and planned monitoring programs within the St. Clair River AOC are described below as they relate to each of the beneficial uses assessed as impaired. In some cases, the workshop participants have recommended specific sampling

frequency to allow the monitoring to respond to the time frame required in several of the RAP objectives (i.e., year 2000). Table 3.1 relates the RAP goals and objectives with specific delisting requirements for each impaired use.

### 9.2.1 Restrictions on Fish and Wildlife Consumption

#### Fish Consumption

A Fish Study conducted by the Michigan Department of Natural Resources is examining contaminants in caged channel catfish over a 3-5 year time frame.

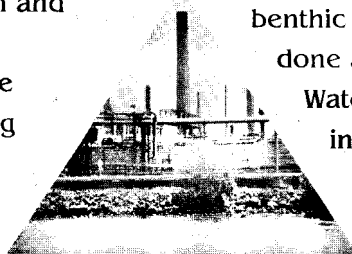
The Sportfish Monitoring Program is conducted by OMOEE and OMNR. The RAP Implementation Committee will request that collections be made on the St. Clair River during 1997 and 2000, in addition

to the collection carried out in 1994.

Recommendations will also be made for designing a statistical sampling method; relate results to ecological biomonitoring programs i.e. contaminants in spottail shiners, in an attempt to determine if contaminant levels in spottail shiners can be used to indirectly determine levels in larger fish; and identify indicator species for more detailed sampling.

MDNR also conducted fish contaminant monitoring in the St. Clair River and Lake St. Clair during 1994.

The EAGLE Project (Effects on Aboriginals from the Great Lakes Environment) is a community based approach to environmental epidemiological study of the effects of environmental contaminants on the health of native people in the Great Lakes Basin. It is based on the presumption that native people, because of their high consumption of fish and wildlife, are frequently more exposed to contaminants in the environment than the general population. The project is ongoing until 1997 and is conducted by Health Canada, the Assembly of First Nations, and Ecosystem Consulting Inc.



### ▲ 9.2.2 Bird or Animal Deformities or Reproductive Problems

Chironomid mouth part (ligula) anomalies were the basis for impairment. The RAP is currently assessing the results of a chironomid study conducted in 1992. Samples were collected at the same sites as the 1986 study and at point source and upstream sites. Additional studies are needed to determine the link between genetic and environmental factors causing these mouth part anomalies. One or two additional sampling surveys are planned between 1994 and 2000.

A 1992 bird colony study has yet to be evaluated. Results of this study will determine subsequent investigations.

### ▲ 9.2.3 Degradation of Benthos

#### **Dynamics of Benthic Populations/Communities**

OMOEE, whole river, benthic community studies are targeted to occur in the year 2000. A 1994, OMOEE benthic community and sediment study was conducted with the objective of characterizing priority 1 impact zones in order to develop remedial options.

Benthic sediment toxicity and chemistry studies are to be conducted annually by the Lambton Industrial Society (LIS). Twenty stations per year will be sampled with most sited within the degraded zone and upstream/downstream control locations. Sampling methods and times will be coordinated with OMOEE and MDNR studies.

#### **Body Burdens In Benthic Organisms**

The effects of organic and inorganic chemicals on benthic organisms is not known. Research is being done at a Great Lakes basin level by the Surface Water Group, OMOEE. Projects and proposals include:

- investigation of the relationship between contaminant levels in chironomids and mayflies and sediments;
- benthic sediment toxicity testing within priority 1 impaired zones in 1994;
- proposed 1994/95 research in collaboration with universities including the identification of biomarkers and reproductive capabilities; and
- a long term monitoring program has been set up by OMOEE. Two sites are in the St. Clair River and three in Lake St. Clair. Sampling is seasonal and includes sediment quality; benthic community structure, zebra mussel information and water quality.

### ▲ 9.2.4 Restrictions on Dredging Activities

This impairment is very specific to areas where dredging takes place in support of navigation and

other marine construction purposes. OMOEE whole river bottom sediment sampling surveys are targeted to occur by the year 2000.

The U.S.ACOE sample dredged sediment from the navigational channels in order to determine disposal requirements i.e. open water disposal or place in a confined disposal facility.

### ■ 9.2.5 Restrictions on Drinking Water Consumption or Taste and Odour Problems

The taste and odour aesthetic objective for ethylbenzene was exceeded on one occasion. LIS conducts a continuous monitoring of volatiles (including ethylbenzene) in order to detect spills that may result in the closure of a water treatment plant.

OMOEE and the Spills Action Centre (SAC) track spill events and closures and determine the cause for each closure. Likewise, the Michigan Pollution Emergency Alert System (PEAS) can be used to track reported spill events.

Monitoring for community spills and ship related spills is not planned.

### ■ 9.2.6 Beach Closings

The Public Health Unit/OMOEE conducts weekly monitoring (5 grab samples 1 day per week) of *E. coli* during the swimming season. The St. Clair County Health Department measures fecal coliform using a geometric mean of 5 samples in a 30 day period during the swimming season (June 1st to Labor Day).

### ■ 9.2.7 Degradation of Aesthetics

Aesthetic degradation is essentially monitored by the public. Aesthetic degradation resulting from a spill would be recorded by SAC (Ontario) and PEAS (Michigan).

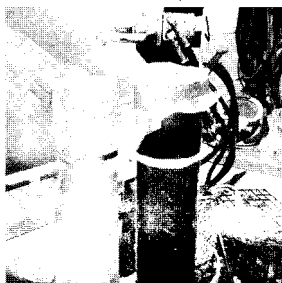
### ■ 9.2.8 Added Cost to Agriculture or Industry

The impairment and monitoring relates to the detection of spills (See Section 9.2.7).

### ■ 9.2.9 Loss of Fish and Wildlife Habitat

Baseline studies are currently being conducted by OMNR in order to inventory and evaluate existing habitat that requires protection. Part of the Stage 2 Process is to identify areas for rehabilitation and protection. This process will involve using a Geographic Information System (GIS) and satellite remotely sensed data. Both changes in forested lands and wetlands can be monitored on an annual basis using these tools.

MDNR, Land and Water Management Division is investigating funding sources for new aerial photos of the state in order to update the Michigan Resources Information System (MIRIS) which is MDNR's GIS land use mapping system. The Southeast Michigan Council of Governments will be taking aerial photos of southeast Michigan during 1995, as part of their five-year update.



### ■ 9.3 Research Needs for Beneficial Uses Requiring Further Assessment

This section identifies research requirements for those beneficial uses assessed as requiring further assessment (Table 2.1), including on a site specific basis and on a Great Lakes Basin basis.

#### ■ 9.3.1 Restrictions on Fish and Wildlife Consumption

##### **Wildlife Consumption**

Restrictions on the consumption of wildlife is a local and a Great Lakes basin wide issue. Currently there are no guidelines with respect to wildlife consumption however, there is evidence of contaminants in wildlife.

Effects related to the consumption of wildlife are being investigated by the EAGLE Project conducted by Health and Welfare Canada, the Assembly of First Nations, and Ecosystem Consulting Inc. The project is ongoing until 1997.

Health and Welfare Canada are developing wildlife consumption guidelines.

Contaminants in wildlife, in particular mink, are being investigated by the Maple Research Centre, OMNR.

### ● 9.3.2 Tainting of Fish and Wildlife Flavour

Official tasting methods and procedures have been established in the USA. A controlled study involving a local taste panel is currently planned by OMOEE and OMNR for 1995.

Discolouration and tainting of muskrat meat from the St. Clair Delta and east side of Lake St. Clair has been reported by the Native community. A controlled study is required.

### ● 9.3.3 Degradation of Fish and Wildlife Populations

#### **Body Burdens in Fish**

The EROD project, conducted by OMOEE measures enzymes in fish liver. Fish are taken from a number of areas and results are being compared to contaminant levels in fish. Project duration is 1994/95.

#### **Dynamics of Wildlife Populations**

The Canadian Wildlife Service (CWS) has several ongoing, annual wildlife community and population studies in progress. These studies include:

- waterfowl monitoring on a seasonal basis;
- Forest Bird Monitoring Program to be undertaken within small woodlots. Commenced in 1994 and ongoing on an annual basis;

- Marsh Bird Monitoring Program started 1993 and continuing on an annual basis; and
- colonial nesting bird and herring gull egg studies are conducted on an annual basis.

Herpetofaunal Survey, an index program for reptiles and amphibians, was started in 1984 and continues on an annual basis. An Ontario Herpetofaunal Atlas is being prepared.

The Atlas of the Breeding Birds of Ontario, resulting from systematic surveys in 1981 to 1985, has provided baseline data and identified 58 rare, endangered or threatened species. As a follow up to the Atlas, the Ontario Rare Breeding Bird Program (ORBBP) was initiated in 1989. 1994 field programs include the Henslow's Sparrow Survey, Loggerhead Shrike and Red-Shouldered Hawk Surveys.



An Atlas of Mammals of Ontario is being prepared and is sponsored by the Federation of Ontario Naturalists and the Ontario Federation of Anglers and Hunters with financial support from OMNR and the Environmental Youth Corps. This Atlas will detail the current and historical distribution of mammals in the province.

A Mammal Atlas is currently being prepared by the U.S. Fish and Wildlife Service.

MDNR conducts annual waterfowl surveys on Harsens Island. These surveys include both harvesting and flyover counts.

#### **Body Burdens of Wildlife**

The effects of contaminants on wildlife is not known. Ongoing projects are listed as follows:

- EROD liver enzyme analysis is conducted by OMOEE;
- piscivorous wildlife guidelines are being developed by New York State;

- federal guidelines for the protection of piscivorous wildlife are being developed by OMOEE and Environment Canada;
- contaminants in waterfowl are monitored by the University of Windsor; and
- contaminants in juvenile fish are monitored on an annual basis by OMOEE.

#### ▲ 9.3.4 Fish Tumours and Other Deformities

Causes and incidences of tumours or other deformities occurring in fish in the St. Clair River AOC have not been scientifically determined. Anecdotal information from anglers in the St. Clair River Delta indicate that deformities in fish may be more common than they were 20 years ago. However, index netting or fish surveys have not been conducted. External tumours are largely attributed to naturally occurring viral infections.

A liver tumour survey was conducted by OMOEE as part of sportfish collections during 1994.

Two further studies are planned. One survey, conducted by OMNR and MDNR will investigate internal and external tumours with sampling sites throughout the St. Clair River with a river headwater site as control. A program investigating contaminants in fish at impact sites has been proposed by MDNR.

#### ▲ 9.3.5 Degradation of Benthos

##### **Body Burdens In Benthic Organisms**

The effects of organic and inorganic substances on benthic organisms continues to be studied. Research is being done at a Great Lakes basin level by the Surface Water Group, OMOEE. Projects and proposals include:

- Investigation of the relationship between contaminant levels in chironomids and mayflies and sediments;

- Benthic sediment toxicity testing within priority 1 impaired zones in 1994;
- Proposed 1994/95 research in collaboration with universities includes the identification of biomarkers and reproductive capabilities; and
- A long term program monitoring program has been set up by OMOEE. Two sites are in the St. Clair River and three in Lake St. Clair. Sampling is seasonal and items monitored include sediment quality; benthic community dynamics, zebra mussel information and water quality.

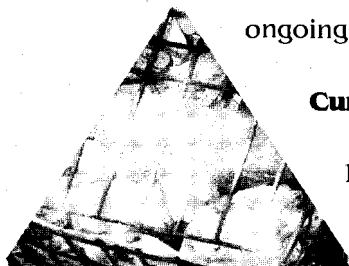
#### ▲ 9.4 Point and Non-Point Source Research and Monitoring Programs

##### ▲ 9.4.1 Non-Point Sources

Several non-point source monitoring programs are ongoing or proposed and include:

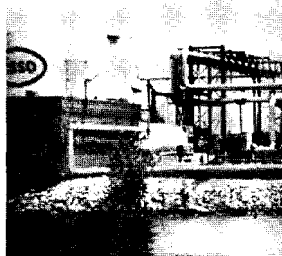
##### **Current/Ongoing:**

1. Environment Canada is conducting a basin wide study which measures contamination from the atmosphere through precipitation. Sampling stations have been set up at the St. Clair Wildlife Station (Lake St. Clair), Manitoulin Island, Pelee Island and Burlington. Precipitation is sampled biweekly.
2. The Environmental Protection Agency has been monitoring airborne pollutants as a result of the start up of the Detroit Incinerator. Sampling stations have been set up on Walpole Island, Windsor and Detroit.
3. The Lambton Industrial Society conducts ambient air sampling on a daily basis in the Sarnia Valley. Approximately 45 parameters are monitored including sulphur dioxide.
4. GLNPO's research vessel, the R/V Lake Guardian, does annual open water monitoring throughout the



Great Lakes. Air monitoring is done via the Integrated Atmospheric Deposition Network (IADN).

5. OMOEE, Surface Water Quality Branch, has been measuring contaminants from the Sydenham River on an annual basis. Results are entered into a GIS and information such as phosphorus loadings vs. land use are calculated.
6. Water quality at the head (Pt. Edward) and mouth (Port Lambton) of the St. Clair River is being sampled biweekly by Environment Canada. This program commenced in 1988 and is still ongoing. Waters are tested for a variety of herbicides and pesticides, HCB and OCS.
7. The nearshore bacti monitoring program initiated in 1993 by OMOEE, Lambton Health Unit and St. Clair Region Conservation Authority will be repeated on an annual basis.
8. Commencing October 1994, the U.S. Department of Agriculture through the Soil and Water Conservation Districts initiated a Southeast Michigan River Basin Study and Environmental Action Plan. This study includes St. Clair County and will follow through with county resource plans by 1996. This project will culminate in the development of a plan addressing non-point source issues. Several federal, state and local agencies, organizations and other interested parties will participate in the project.



#### **Proposed:**

1. Detailed watershed investigations are required in both Michigan and Ontario to determine sources and pathways of contaminants derived from rural non-point sources. The investigations should identify opportunities for remedial/preventative measures.
2. OMOEE is developing models for airborne chemicals and loadings to the St. Clair River AOC.

## ■ 9.4.2 Point Sources

OMOEE already has industrial self-monitoring in place. New monitoring requirements will be specified in the MISA effluent regulations once they are promulgated. Ongoing compliance monitoring for the MISA program is conducted by OMOEE.

MDNR requires all facilities to conduct effluent monitoring and report results monthly through the NPDES Permit system. MDNR conducts compliance sampling inspections at all permitted facilities.

Additional monitoring may be required at certain facilities to ensure priority sources/parameters are according to the actions identified by the Point Source Task Team.

Contaminants in Combined Sewer Overflows are event based and monitored by MDNR through NPDES Permit regulations.

Urban runoff during storm events at industrial sites in Michigan are monitored by MDNR through NPDES Permit regulations.

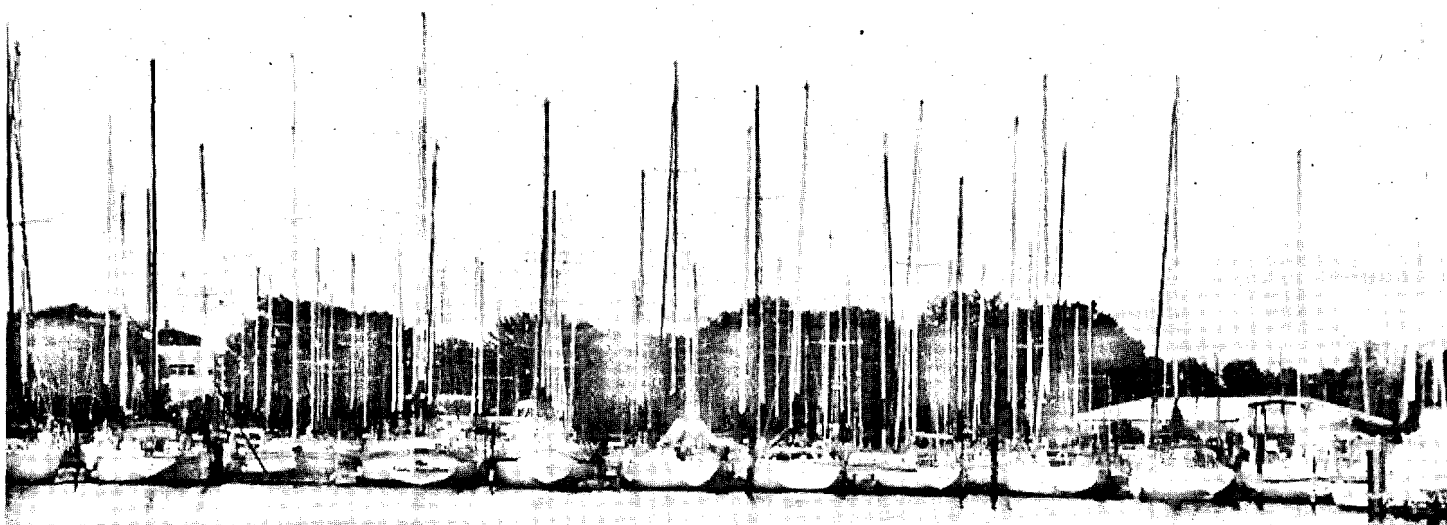
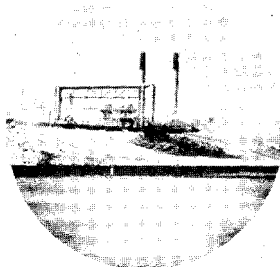
## ■ 9.5 Actions

1. Based on the research and monitoring needs determined in the previous sections, develop detailed workplans which specify the following:
  - responsible agency and funding mechanism;
  - study design, including locations, frequencies, target media, and analytical techniques;
  - target contaminants; and
  - respective "yardstick" values.
2. In developing the workplans, the following should be considered:
  - which monitoring and research needs can be met simultaneously with comprehensive studies, and how;

- who is best suited to conduct certain studies either independently or cooperatively;
  - redundancy is eliminated and gaps are filled;
  - recognition that resources are limited; and
  - design studies so that they will fulfil our needs, as well as serve other applications where feasible.
3. A spatial database should be developed for tracking and assessing monitoring results. This database would utilize the spatial GIS framework being developed as part of the RAP process. Such a database would enhance the analytical and interpretive capabilities of those responsible for implementation by allowing analytical comparisons and summaries, relative ease of use of the KETOX model (for yardstick comparison), rapid, clear visualization of the results. Such a database must include results from previous studies including actual sample-site data.

Modelling Requirements based on recommendations from Nettleton (1994):

1. Build a more comprehensive river background database in order to improve model accuracy.
2. Attempt to quantify localized atmospheric deposition of the contaminants modelled.
3. Analyze the dynamic changes in chemical levels in the bed sediment by using both modelling and field data analysis.
4. Conduct a stochastic modelling analysis in order to derive effluent loading limits.



**W**here conclusive information is lacking, actions listed in this document will be further evaluated for their linkages with identified impairments and prioritized in light of competing environmental initiatives and expected benefits to the St. Clair River and surrounding environment.

The next step in the RAP process will focus on:

- prioritizing actions that will clearly lead to removal of impairments;
- obtaining commitments (including funding) from those responsible and proceed with carrying out the priority actions listed in this document; and
- further refining plans for those areas where the remedial actions have not yet been fully developed.

RAP participants have attempted to prescribe actions for delisting of the St. Clair River as an Area of Concern. Some actions may yield greater environmental benefits and would receive a higher priority in committing limited resources. The RAP is principally concerned with restoring impairments to beneficial uses and, as such, will prioritize these actions while promoting other actions which will further improve environmental conditions in the area.

Implementation of the RAP will involve four components: (1) the establishment of the responsible entities and management structure; (2) tools and procedures to track implementation; (3) evaluation of the success of remedial activities; (3) appropriate funding to undertake actions; and (4) propose additional actions, as needed.

## ▲ 10.1 Management Structure

The overall strategy for implementation of the St. Clair River RAP is to have the recommended actions of this Report carried out directly by the agencies, facilities, other organizations involved in the

development of the RAP and/or committed to specific actions, and the general public. To do this, coordinating and accountability bodies are required.

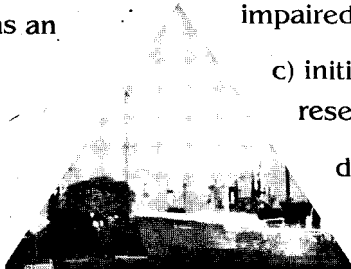
Two working committees are required: (1) a RAP Implementation Committee; and (2) a Public Accountability Committee (BPAC). The two committees must operate independently of each other to ensure accountability. Current members of BPAC should have the flexibility to join of the RAP Implementation Committee or subcommittees, or leave the formal process and work on RAP implementation directly through their own organizations.

### (1) RAP Implementation Committee (RIC)

The purposes of this committee are to:

- a) coordinate implementation activities;
- b) update problem definitions and restoration of impaired uses;
- c) initiate and respond to monitoring and research results/activities;
- d) undertake data assessment and make remedial decisions/recommendations;
- e) track progress and schedules relating to remedial actions;
- f) undertake educational activities;
- g) produce short biennial reports, including update of problems, progress of remedial actions, further recommendations, progress towards goals and objectives;
- h) review and track agency programmes, activities, regulations, and lobby, accordingly;
- i) coordinate activities with all parties responsible for remediation, agencies and other stakeholders; and
- j) provide meeting minutes, data, updates, etc. to the accountability committee regularly and upon request.

This committee should be kept small (approximately 12 to 15 members). It should



consist of representatives of all sectors responsible for implementation of the RAP, such as industrial, municipal, OMOEE, OMNR, MDNR representatives. A representative of the Friends of the St. Clair River should be on the Implementation Committee to ensure coordination with their educational projects.

The RAP Implementation Committee should set up ad hoc working groups, as necessary, to carry out specific functions, for example, to develop a contaminated sediments workplan. Membership on the subcommittees should be based on specific interests and expertise and be open to individuals beyond those already sitting on the RAP Implementation Committee.

## **(2) RAP Public Accountability Committee (BPAC)**

The purposes of this committee which is evolving from the BPAC are to:

- (a) audit the implementation of the RAP;
- (b) evaluate progress towards goals, objectives and delisting;
- (c) review the environmental monitoring results;
- (d) provide advice on priorities and directions to the RAP Implementation Committee and its subcommittees; and
- (e) issue an annual report to the public which assesses progress on the RAP.

Regular meetings of this committee should be relatively infrequent. Comments should be supplied to the RAP Implementation Committee twice yearly. The RAP Accountability Committee should also issue an annual audit directly to the public. Committee members should receive the minutes and correspondence relating to the other committees on a regular basis. Special meetings of this committee could be called at the discretion of some minimum number of members if any issues of concern arise.

## **10.2 Implementation Strategies**

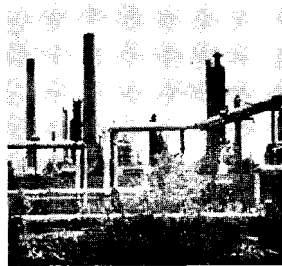
As described in the Stage 1 Report, Stage 1 Addendum Report, and herein, completed and ongoing actions in the Area of Concern have resulted in substantial improvements to environmental conditions. Further actions are necessary to delist the St. Clair River as an Area of Concern and it is these actions which must be implemented or initiated before the end of the decade.

Because of the progress which has been made, further improvements will be more difficult to predict and measure. In some instances, the RAP is dealing with the last 10 percent of a problem with upwards of 90 percent reductions in industrial point source discharges of contaminants to the river already

achieved. In this regard, the RAP will need to focus on establishing a linkage between sources and impact in the environment. To this point, some source actions can be definitively linked to restoring impairments of beneficial uses while others cannot. Priority in the short term will be given to implementing the former, while further evaluation of these latter

actions will be necessary in order that their priority for action and commitments can be determined. It is important to acknowledge, however, that the state of environmental science cannot definitively establish in all cases a strong cause-effect linkage. The RAP, through consultation with experts and stakeholders has and will through lines of evidence, promote actions which although not directly linked to an impairment are expected to yield environmental benefits in the St. Clair River and watershed. These actions will be prioritized against other actions where either strong or no cause-effect linkages can be established.

Implementation strategies relate specifically to funding and commitments to action. The RAP Team and BPAC have involved local industry in determining current and projected loadings. In addition, the

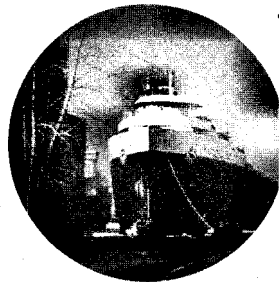


facilities have been asked to provide written commitments as to their projected loadings of priority parameters. The funding to meet these projected loadings will be borne by each facility.

Funding in support of the administration of RAP implementation will be borne by the responsible agencies (OMOEE, MDNR, Environment Canada, U.S. EPA).

Targets for restoration of degraded areas and the conservation and protection of human and ecosystem health have been established under the Canada-Ontario Agreement (COA). The remedial actions outlined in this document are largely consistent with these targets and indeed some (those under the jurisdiction of Canada/Ontario) may benefit from priorities established as part of the Agreement.

Funding in support of the required monitoring program will vary greatly from year to year. Most of the monitoring information will be provided through existing agency, facility, and LIS monitoring programs. It is expected that the responsible agencies will continue to fund these programs. In addition, there may be opportunities to undertake joint agency-industry monitoring such as the recent initiative between LIS and OMOEE regarding sediment characterization studies.



- the RAP goals and objectives as related to delisting criteria;
- specific remedial actions proposed to delist use impairments;
- identification of responsible agencies, facilities, organizations, etc.;
- time frame/target dates for implementation/ completion of actions;
- funding sources, resource allocations and disbursements (government and industry);
- actual parameter loadings as compared to projected and required loadings;
- monitoring and research data evaluation (whether or not conducted and key results);
- public outreach and education activities; and
- an assessment of whether targets are being met and, if not, mechanisms to respond.

Table 10.1 summarizes the remedial and preventative measures presented in Chapters 4 through 10 according to responsible agency(ies) and completion date.

This table also provides the basis for developing a detailed workplan matrix as noted above. The evaluation of success will be based on the progress towards meeting the goals of objectives within the time frames stated.

### ● 10.3 Tracking and Evaluation Mechanisms

The first section of this chapter outlined the committee structure to implement and monitor the RAP. This section focuses on the mechanisms by which progress will be evaluated and the results of monitoring tracked. The RAP Implementation Committee will develop a detailed implementation workplan which utilizes a matrix or spreadsheet approach. The information required for tracking success of implementation will consist of the following:

Table 10.2 provides a first approximation of funding required on behalf of public agencies in order to implement specific actions identified in Table 10.1. The costs range from fairly specific, in the case of municipal infrastructure requirements, to 'ball park' in value. They are not intended to cover all public funding required to implement the RAP as, for example, there is no consideration of actions identified under Section 8 (Public Outreach and Consultation) or Section 9 (Monitoring and Research). These funding requirements along with

Summary of significant actions, responsible agencies or facilities, and completion date (by task) for the implementation of the St. Clair RRP. *Agencies/facilities noted are those with primary responsibility and are not meant to be all inclusive with regard to funding sources.*

| Issue/Action                                                                                                                                   | Agency/Facility                                                                                       | Completion Date for Specific Actions <sup>(1)</sup>                                                                              |
|------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| <b>POINT SOURCE</b>                                                                                                                            |                                                                                                       |                                                                                                                                  |
| <b>Persistent and Bio-accumulative Substances</b>                                                                                              | Cole Drain; Dow; Corunna WPCP; Ethyl; Port Huron WWTP; Sarnia WPCP; St. Clair WWTP                    | 1995 -determine whether meet or exceed yardstick<br>2000 -meet yardstick<br>2004 -virtually eliminate from discharge             |
| <b>Persistent, (Potentially Bioaccumulative Substances)</b>                                                                                    | Dow; Ethyl; Corunna WPCP; Imperial Oil Refinery; Novacor (Corunna); Sarnia WPCP; Shell Canada; Suncor | 1995 -determine whether meet or exceed yardstick<br>2000 -meet yardstick at end of pipe                                          |
| <b>Persistent Parameters (Not Bioaccumulative)</b>                                                                                             | Sarnia WPCP                                                                                           | 2000 -meet yardstick at edge of mixing zone                                                                                      |
| <b>Non-Persistent, Non-Bioaccumulative Substances</b>                                                                                          | Ethyl; Imperial Oil Refinery; Marysville WWTP; Polysar; Port Huron WWTP; Sarnia WPCP                  | 2000 -meet yardstick at edge of mixing zone                                                                                      |
| <b>Source Discharges of Coliform Bacteria</b>                                                                                                  | MDNR (CSOs); All WPCP & WWTP; Municipalities                                                          | 2000 -50% reduction from Sarnia WPCP<br>2000 -all WPCP/WWTP effluents disinfected<br>2005 -completely eliminate from Sarnia WPCP |
| <b>CSO Elimination</b>                                                                                                                         | Port Huron; Marysville; Sarnia                                                                        | 2001-Marysville<br>2005-Port Huron and Sarnia                                                                                    |
| <b>Point Source Discharges to Air</b>                                                                                                          | RIC; All Sources; EPA                                                                                 | 1994/95 -inventory of atmospheric releases for all yardstick substances<br>1996 -develop means to define impacts                 |
| <b>Eliminate Spills</b>                                                                                                                        | All Point Sources                                                                                     | 2000                                                                                                                             |
| <b>Pollution Prevention/ Toxics Release Plan</b>                                                                                               | All Point Sources not meeting yardsticks                                                              | December 1995                                                                                                                    |
| <b>Setting new yardsticks and adjusting existing (as required)</b>                                                                             | MDNR; OMOEE                                                                                           | ongoing                                                                                                                          |
| <b>Develop discharge permits on the basis of discharges already approved or under application and assess total mass loadings to the river.</b> | MDNR; OMOEE                                                                                           | ongoing                                                                                                                          |
| <b>Develop whole plant permitting system</b>                                                                                                   | MDNR; OMOEE                                                                                           | 1994 and ongoing                                                                                                                 |
| <b>Elimination of all discharges/ leachate to Cole Drain</b>                                                                                   | All relevant point sources                                                                            | 2004                                                                                                                             |
| <b>Small business toxic reduction education</b>                                                                                                | OMOEE; MDNR; Environment Canada                                                                       | 1993 and ongoing                                                                                                                 |
| <b>Assess storm water impacts</b>                                                                                                              | All facilities; MDNR; EPA                                                                             | 1997/99 - Ontario<br>1995/96 - Michigan                                                                                          |
| <b>Zero discharge</b>                                                                                                                          | All Point Sources                                                                                     | To be determined - ongoing                                                                                                       |

**Issue/Action****Agency/Facility****Completion Date for Specific Actions <sup>(\*)</sup>****NON-POINT SOURCE**

|                                                                                                     |                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Watershed/Subwatershed Management Plans</b>                                                      | MDNR; OMOEE; OMNR; EPA; Environment Canada; USDA/SCS                                 | 1997 -draft Ontario and Michigan watershed plans                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Urban runoff for new developments</b>                                                            | Municipalities; Developers                                                           | 1994 -enforce bylaws re: on-site pollution control<br>1995 -maintain natural areas<br>2000 -maintain pre-development hydrography                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Urban runoff for existing developments</b>                                                       | Municipalities; Developers                                                           | 2000 -construct on-site controls to remove pollutants                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Link Urban/Rural stormwater control through subwatershed plans</b>                               | Municipalities; Conservation Authorities                                             | 1994 and ongoing                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Reduce use of road salt and seek alternatives</b>                                                | Transport Agencies in Ontario and Michigan; MDNR; OMOEE; Municipalities/Local Gov'ts | 1994 and ongoing                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Reduce use of lawn fertilizers and pesticides</b>                                                | Residents; Municipalities                                                            | 1994 and ongoing                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Promote agricultural programs and technology to reduce contamination to rural runoff</b>         | OMAFRA; MDNR; Agriculture Canada; MDA; USDA/SCS                                      | ongoing since 1993                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Protect existing natural areas and undertake remedial measures</b>                               | OMOEE; OMNR; MDNR; Local Governments; Conservation Authorities                       | 1993 and ongoing                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Improved waste site planning and management</b>                                                  | OMOEE; MDNR; Municipalities                                                          | 5 year phase in -incentives for disposal of wastes; implement pollution prevention measures<br>1993 and ongoing -sites only accept waste designed to handle; secure monies to avoid abandonments; ensure proper closing of all bore holes and wells<br>1994 -BAT for new waste sites; up-to-date inventory of sites and site condition; licensed/insured/bonded haulers<br>1995 and ongoing -improved accountability of waste disposal practices; properly cap closed sites determine extent of contamination of existing sites; monitor site conditions and shallow groundwater<br>2000 and ongoing -mitigate and remediate contaminated groundwater |
| <b>Identify problems relating to domestic sanitary sources and ensure proper maintenance/repair</b> | Municipalities; Residents; Public Health Authorities                                 | 1993 and ongoing                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Correct direct discharges of untreated grey water</b>                                            | Municipalities; OMOEE; MDNR; U.S. and Canadian Coast Guards                          | 1994 and ongoing                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Proper use and disposal of household hazardous wastes and product substitution/education</b>     | Municipalities; Residents                                                            | 1994 and ongoing                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

cont'd

| Issue/Action                                                                                                 | Agency/Facility                                                                                                                                                              | Completion Date for Specific Actions <sup>(*)</sup>                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>S E D I M E N T</b>                                                                                       |                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Complete sediment characterization studies                                                                   | OMOEE; LIS; Environment Canada; Geological Survey of Canada; EPA; SEMI; MDNR; USACOE                                                                                         | 1994/95 -OMOEE/LIS sediment characterization study<br>1995 -Priority 1 Zones follow-on sediment characterization studies<br>1995 -review study of sediment transport mechanisms.                                                                                                                                                                                                                                                  |
| Undertake in-situ pilot scale remediation                                                                    | OMOEE; LIS; Environment Canada; USACOE                                                                                                                                       | 1996 -begin pilot studies                                                                                                                                                                                                                                                                                                                                                                                                         |
| Develop final remedial strategy                                                                              | OMOEE; LIS; Environment Canada; USACOE                                                                                                                                       | 1998                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>H A B I T A T</b>                                                                                         |                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Develop and implement communications/education program and appropriate landowner guidelines                  | RIC; BPAC; EPA; MDNR; Environment Canada; OMNR                                                                                                                               | 1995 and ongoing                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Strengthen wetland protection measures                                                                       | Ontario and Michigan Legislatures; Environment Canada; EPA                                                                                                                   | 1995 and ongoing                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Reduce ship wakes and surges and minimize impacts from winter shipping                                       | U.S. and Canadian Coast Guards; MDNR; USACOE; USFWS                                                                                                                          | 1994 and ongoing                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Ensure protection of shorelines from erosion and protect/enhance/restore other natural habitats in watershed | MDNR Surface Water Quality Division Nonpoint Source Program; USDA Natural Resource Conservation Service (Soil Conservation Service); OMNR; Landowners; Conservation Agencies | 1994 and ongoing                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Control/eradicate exotic species                                                                             | OMNR; MDNR                                                                                                                                                                   | 1994 and ongoing                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Undertake habitat restoration and enhancement measures                                                       | OMNR; OMOEE; MDNR; RIC; Conservation Agencies; Environment Canada; EPA                                                                                                       | 1994 - Stag Island restoration; develop combatable mapping for Ontario and Michigan<br>1994 and ongoing -maximize fish use of delta habitats; encourage maintenance/enhancement of riparian vegetation; implement candidate sites projects; expand candidate sites in Ontario and Michigan; acquire Harsens Island property; improved co-ordination among conservation/protection agencies; expand list of special status species |
| Develop long term habitat management plan                                                                    | OMNR; MDNR; EPA; Environment Canada; All Conservation Agencies                                                                                                               | 2000 - develop a long term habitat management plan for both Ontario and Michigan. Plan will include a GAP analysis that assess needs related to maintain wildlife diversity and integrity.                                                                                                                                                                                                                                        |

cont'd

**Issue/Action****Agency/Facility****Completion Date for Specific Actions <sup>(\*)</sup>****PUBLIC EDUCATION AND OUTREACH****Develop and implement  
public involvement program**

RIC; BPAC

1994 and ongoing

**Develop and implement  
public outreach and  
education programs**

RIC; BPAC

1994 and ongoing

**MONITORING AND RESEARCH****Develop detailed monitoring  
workplans**

RIC; BPAC

1995

**Complete GIS analytical  
spatial database**

RIC

1994

**Implement monitoring  
programs and update GIS  
database**

RIC; LIS; All Agencies

1994 and ongoing

**Acquire additional  
information to improve  
modelling accuracy**

OMOEE; MDNR

1994 and ongoing

**RAP IMPLEMENTATION****Establish RAP  
Implementation and Public  
Accountability Committees**RAP Team; BPAC; OMOEE;  
OMNR; MDNR; Environment  
Canada; EPA

1994

**Complete implementation  
workplan**

RIC

1995

(\*) Contingent on emerging information and RAP priorities.

# Approximation of costs required on behalf of public agencies to implement selected actions from Table 10.1.

| Responsible Public Agency(ies)                               | Action                                                                                                                             | Estimated Cost (\$ Approximate)     |
|--------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| <b>Ontario, Canada (\$ Cdn)</b>                              |                                                                                                                                    |                                     |
| City of Sarnia                                               | Holding tanks for four CSOs (Devine, Cromwell, Exmouth & Wellington Sts.)                                                          | 11,700,000                          |
|                                                              | Sewage Treatment Plant upgrade                                                                                                     | 33,000,000                          |
|                                                              | Storm sewer retention pond and collector sewers                                                                                    | 6,700,000                           |
| OMOEE; Environment Canada                                    | Contaminated sediment characterization using in-situ pilot and bench-scale tests (1995-1998)                                       | 1,000,000                           |
| OMOEE                                                        | Sarnia office GIS database final assembly and modelling (FY 1995/96)                                                               | 100,000                             |
|                                                              | GIS database ongoing updating and analysis (annual)                                                                                | 50,000                              |
|                                                              | CURB Program funding (annual)                                                                                                      | Continued funding                   |
|                                                              | Air quality modelling for AOC airshed (1995/96)                                                                                    | 150,000                             |
| OMOEE; OMNR; Conservation Authority; Environment Canada      | Habitat diversity GAP analysis and watershed management plan for Cole Drain, Baby Creek, Talfourd Creek and Clay Creek (1995-1997) | 300,000                             |
| OMNR*                                                        | Habitat enhancement/restoration program:                                                                                           |                                     |
|                                                              | • Darcy Mckeough Floodway                                                                                                          | 75,000                              |
|                                                              | • MacDonald Park                                                                                                                   | 60,000                              |
|                                                              | • Bear Creek wetland complex                                                                                                       | 1,600,000                           |
|                                                              | • Stag Island                                                                                                                      | 1,350,000                           |
| OMOEE; OMNR; Environment Canada; Fisheries and Oceans Canada | Ongoing support of RAP Implementation Committee and BPAC activities                                                                | Minimum of existing resource levels |
| <b>Michigan/U.S. (\$ U.S.)</b>                               |                                                                                                                                    |                                     |
| City of Port Huron                                           | Full implementation of CSO control plan, elimination of 20 outfalls on the Black and St. Clair Rivers                              | 90,000,000                          |
| City of Marysville                                           | Separation of all combined sewers comprising one remaining outfall by 2001                                                         | 5,000,000                           |
| St. Clair County Metropolitan Planning Commission            | Development of GIS database for land use planning – start-up costs                                                                 | 80,000                              |
| SEMI; USACOE; EPA; MDNR                                      | Initial St. Clair tributaries sediment assessment in Black, Pine and Belle Rivers (1995)                                           | 65,000                              |
| Lapeer County Soil & Water Conservation District             | 319 Planning grant to address agricultural non-point source problems on headwaters of Belle River (FY 1995/96)                     | 100,000                             |
| St. Clair County Health Department                           | Conduct initial failed septic systems study in target areas – water quality monitoring and dye testing                             | 80,000                              |
| MDNR; EPA; USFWS; NBS                                        | Habitat/wetland inventory of non-coastal areas of the western St. Clair River watershed                                            | 150,000                             |
| MDNR; EPA                                                    | Ongoing support of RAP Implementation Committee and BPAC activities                                                                | Minimum of current resource levels  |

\*Funding to be secured through numerous public and private partnerships with federal/provincial contribution expected to be 25% to 50% of total.

other non-costed actions will need to be determined by the RIC as noted above.

## ▲ 10.4 Public Role and Responsibilities

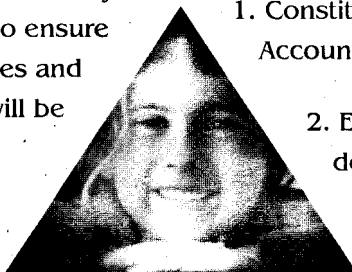
The success of implementation of the St. Clair River RAP will depend in large part on active participation by the public. In particular, actions have been defined relating to household hazardous waste reduction/elimination, contributions to rural and urban runoff, protection and enhancement of habitat (wetlands and upland habitats), and broader waste reduction/elimination programs on behalf of householders and commercial enterprises. To be successful, these actions must be implemented with the full co-operation and endorsement by the local public.

The public must also assume a greater responsibility for implementation of all remedial actions to ensure accountability on behalf of agencies, facilities and the RAP Implementation Committee. This will be particularly important to assure that environmental integrity within the St. Clair River and its watershed is maintained long after the formal RAP Process is complete.



## ▲ 10.5 Actions

1. Constitute RAP Implementation and RAP Accountability Committees.
2. Establish detailed workplan/matrix (as defined in Section 10.3) to implement and track success of remedial actions.
3. A GIS database currently being developed as part of the RAP process will be enhanced with respect to site specific contaminant and habitat data (see Section 9.5). These data, in combination with those already incorporated into the spatial database (1993 Landsat scene, present and historical wetlands, KETOX model input capability, and land use), will be a powerful tool to assist in tracking and evaluation functions. In addition, the data will be in an accessible form to assist the RAP Accountability Committee in confirming the success of implementation and in preparing clear, concise reports.
4. A funding sources database will be developed to facilitate and expedite research and monitoring and aid implementation of public education and other preventive and remedial activities.



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## Support Glossary

|                |                                                                                                                                                                                              |                        |                                                                                                                                                                                                          |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ABSORPTION     | Penetration of one substance into the body of another.                                                                                                                                       | AMBIENT                | An encompassing surrounding.                                                                                                                                                                             |
| ACCLIMATION    | Physiological and behavioural adjustments of an organism in response to a change in environment. See also Adaptation.                                                                        | AMBIENT STANDARDS      | The concentration of a toxic substance in the water, which based on available data, will not result in significant risks of adverse effects to biota or human health.                                    |
| ACCUMULATION   | Storage of a chemical or substance in tissue. May also apply to the storage and concentration of a chemical in aquatic sediments to levels above those that are present in the water column. | AMBIENT WATER          | The water column or surface water (lake, river, etc.) as opposed to groundwaters or sediment pore water.                                                                                                 |
| ACUTE          | Involving a brief exposure to a stimulus. In toxicity tests, a duration of 96 hours is typically considered acute.                                                                           | ANADROMOUS             | Species which migrate from salt water to freshwater to breed.                                                                                                                                            |
| ACUTE TOXICITY | Mortality or other toxic effects that are produced within a short period of time, usually 24 to 96 hours.                                                                                    | ANAEROBE               | An organism for whose life processes a complete or nearly complete absence of oxygen is essential.                                                                                                       |
| ADAPTATION     | Change, often genetically based, in the structure, forms or behaviour of an organism to accommodate changing environmental conditions. See also Acclimation.                                 | ANOXIA                 | The absence of oxygen. In aquatic ecosystems this refers to the absence of dissolved oxygen in water, a situation which cannot be tolerated by most aquatic organisms.                                   |
| ADIPOSE        | Of, like, or containing animal fat: Fat in the connective tissue of an animal's body.                                                                                                        | ANTAGONISM             | Reduction of the effect of one substance because of the introduction or presence of another substance; e.g. one substance may hinder, or counteract, the toxic influence of another. See also Synergism. |
| ADSORPTION     | The taking up of one substance onto the surface of another.                                                                                                                                  | ANTHROPOGENIC          | Origin a consequence of human-related activities.                                                                                                                                                        |
| AEROBIC        | The condition associated with the presence of free oxygen in the environment.                                                                                                                | AQUATIC                | Living in water.                                                                                                                                                                                         |
| ALGA (E)       | Simple one-celled or many-celled micro-organisms, usually free-floating, capable of carrying on photosynthesis in aquatic ecosystems; a form of aquatic plant.                               | ASSIMILATION           | The absorption, incorporation and metabolism of substances. For example nutrients can be absorbed and processed, or assimilated, by an organism or ecosystem.                                            |
| ALGICIDE       | A specific chemical, highly toxic to algae. Algicides are often applied to water to control nuisance algal blooms and may contain harmful contaminants such as heavy metals.                 | ASSIMILATIVE CAPACITY  | The ability of a waterbody to transform and/or incorporate substances (e.g. nutrients) by the ecosystem, such that the water quality does not degrade.                                                   |
| ALKALINITY     | A measurement of acid neutralization of buffering capability of a solution (see pH).                                                                                                         | ATMOSPHERIC DEPOSITION | Pollution from the atmosphere associated with dry deposition in the form of dust, wet                                                                                                                    |
| ALKYLATED LEAD | A contaminant in the environment, resulting mainly from burning leaded gasoline, but also found in some industrial emissions.                                                                |                        |                                                                                                                                                                                                          |

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|                         | deposition in the form of rain and snow, or as a result of vapour exchanges.                                                                                                                                                                                                                          | BIOMAGNIFICATION  | The increasing concentrations of a chemical in biota, moving up the food chain. Trace organic contaminants tend to be at greater concentrations in top predators than in lower levels of the food web.                                                                                                                                                                        |
| BENTHIC                 | Of or living on or in the bottom of a water body; benthic region, benthos.                                                                                                                                                                                                                            | BIOMASS           | Total weight of all or specific organisms usually expressed for a given area or volume of water or sediment.                                                                                                                                                                                                                                                                  |
| BENTHOS                 | Bottom dwelling organisms, the benthos comprise: 1) stationary animals such as sponges, some worm species and attached algae; 2) creeping forms such as snails and flatworms; and 3) burrowing forms which include most clams, worms, freshwater shrimp, mayflies and midges and other insect larvae. | BIOMONITORING     | The use of organisms to test the toxic effects of substances in effluent discharges or the surrounding environment as well as the chronic toxicity of low-level pollutants in the aquatic environment.                                                                                                                                                                        |
| BENZO(A)PYRENE          | A PAH (polycyclic aromatic hydrocarbon) which is a suspected carcinogen found in cigarette smoke. It is a byproduct of combustion and is released to the aquatic environment from industrial processes such as steel and aluminum making.                                                             | BIOTA             | Plants and animals.                                                                                                                                                                                                                                                                                                                                                           |
| BIOACCUMULATION         | Uptake and retention of substances, including nutrients and contaminants, by an organism from both its environment (i.e. directly from the water) and its food.                                                                                                                                       | BIOTRANSFORMATION | Enzymatic conversion of a compound to another compound within a living organism. Can result in less toxic or in more toxic substances.                                                                                                                                                                                                                                        |
| BIOASSAY                | A biological assessment of water or sediment designed to evaluate toxicity of contaminants to an organism.                                                                                                                                                                                            | BIOTURBATION      | Biological mixing of sediment by benthic organisms which results in physical, chemical and/or biological changes in sediment to a depth generally not greater than 10 cm. Can result in the transport of contaminants from sediment into the water column.                                                                                                                    |
| BIOAVAILABILITY         | The portion of the total chemical(s) in the surrounding environs, i.e. water, sediment, which is available for uptake by organisms (plant, animal). The biologically reactive amount of a substance in the environment.                                                                               | CARCINOGEN        | Cancer-causing chemical or substance.                                                                                                                                                                                                                                                                                                                                         |
| BIOCHEMICAL             | The amount of dissolved oxygen required for the bacterial decomposition                                                                                                                                                                                                                               | CHIRONOMID        | Any of a family of midges that lack piercing mouth parts as adults. Larval forms are sediment dwelling burrowing invertebrates that are an important food source for bottom feeding species such as fish.                                                                                                                                                                     |
| OXYGEN DEMAND           | of organic waste in water.                                                                                                                                                                                                                                                                            | CHRONIC           | Duration of exposure to an environmental stress that is prolonged.                                                                                                                                                                                                                                                                                                            |
| BIOCONCENTRATION        | The ability of an organism to concentrate substances within its body at concentrations greater than in its surrounding environment or food.                                                                                                                                                           | CHRONIC TOXICITY  | Toxicity observed following a long duration of exposure, that produces an adverse effect on organisms. The end result of chronic toxicity can be death although the usual effects are sublethal; e.g. reproduction or growth inhibition. These effects can be reflected by change in the productivity and structure of the population and community. See also Acute Toxicity. |
| BIOCONCENTRATION FACTOR | The ratio of the measured residue within an organism compared to the residue of the substance in the ambient air, water or soil environment of the organism.                                                                                                                                          | COMMUNITY         | Group of populations of plants and animals interacting in given place; ecological unit                                                                                                                                                                                                                                                                                        |
| BIODEGRADATION          | The chemical breakdown/decomposition of a compound by bacteria/micro-organisms.                                                                                                                                                                                                                       |                   |                                                                                                                                                                                                                                                                                                                                                                               |

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|                         | used in a broad sense to include groups of various sizes and degrees of integration.                                                                                                                                                                                                         |                   |                                                                                                                                                                                                                                                                                                                                |
| CONGENER                | A member of the same taxonomic genus as another plant or animal: Also, a different configuration or mixture of a specific chemical usually having different toxicological properties.                                                                                                        | CUMULATIVE        | Brought about or increased in strength by successive additions, i.e. effects produced by simultaneous dose of two or more chemicals, or repetitive dose effects of more than one chemical may occur in three ways:                                                                                                             |
| CONSUMPTIVE USE         | Permanent removal of water from a water body. Consumptive use may be due to evaporation, agricultural use, or incorporation of water into a manufactured product.                                                                                                                            |                   | (1) additive effects - sum of the individual effects;                                                                                                                                                                                                                                                                          |
| CONTAMINANT             | A substance foreign to a natural system or present at unnatural concentrations in air, water, soil or food, causing use of those things to be limited. A naturally occurring substance may be found to exceed government guidelines, or objectives and be called a contaminant, e.g. metals. |                   | (2) antagonistic effects - effect of one chemical is reduced by the present of another chemical(s);                                                                                                                                                                                                                            |
| CONTAMINATION           | The introduction of pathogenic or undesirable micro-organisms, toxic and other deleterious substances which can render water, air, soils or biota unfit for use or unhealthy.                                                                                                                | CUMULATIVE ACTION | (3) synergistic effects - presence of one or more chemicals produces effects greater than the sum of individual effects.                                                                                                                                                                                                       |
| CONTROL ORDER           | Enforceable orders in Ontario, often applied to industrial facilities.                                                                                                                                                                                                                       |                   | Increasingly severe effects due to either storage or concentration of a substance within the organism.                                                                                                                                                                                                                         |
| COD                     | A term used to describe substances which consume oxygen upon decomposition.                                                                                                                                                                                                                  | DENSITY           | Number of individuals in a given space.                                                                                                                                                                                                                                                                                        |
| CONVENTIONAL POLLUTANT  | Materials which produce an oily sludge deposit, and bacteria. Conventional pollutants include phosphorus, nitrogen, chemical oxygen demand, biochemical oxygen demand, oil and grease, volatile solids, and total and fecal coliform, chlorides, etc.                                        | DETRITUS          | Organic residue of plant and animal origin that has undergone decomposition.                                                                                                                                                                                                                                                   |
| CRITERIA                | Numerical limits of pollutants typically established to protect the aquatic ecosystem and human use of the ecosystem.                                                                                                                                                                        | DIATOM            | Any of a class of minute planktonic unicellular or colonial algae with skeletons of high silica content.                                                                                                                                                                                                                       |
| CRITERIA, WATER QUALITY | Designated concentrations for water quality constituents based on scientific evidence and judgement, that, when not exceeded will protect an organism, a community of organisms, or a prescribed water use with an adequate degree of assurance.                                             | DIELDRIN          | A chlorinated pesticide that is persistent and bioaccumulates in all living organisms; causes reproductive disorders in wildlife and is a known carcinogen.                                                                                                                                                                    |
|                         |                                                                                                                                                                                                                                                                                              | DIOXIN            | A group of approximately 75 chemicals of the chlorinated dibenzodioxin family, including 2,3,7,8 - tetrachlorodiobenzo-para-dioxin (2,3,7,8 - TCDD) which is generally considered the most toxic form. Can be formed when naturally occurring organic molecules come in contact with chlorine introduced into the environment. |
|                         |                                                                                                                                                                                                                                                                                              | DIFFUSE SOURCE    | A source of pollution that is not distinct and is widely distributed, such as atmospheric deposition and agricultural or urban runoff.                                                                                                                                                                                         |
|                         |                                                                                                                                                                                                                                                                                              | DISSOLVED OXYGEN  | The amount of oxygen dissolved in water.                                                                                                                                                                                                                                                                                       |
|                         |                                                                                                                                                                                                                                                                                              | DRAINAGE BASIN    | A body of water and the land area drained into it.                                                                                                                                                                                                                                                                             |

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| <b>DREDGE SPOILS</b>       | The material removed from the river, lake or harbour bottom during dredging operations.                                                                                                                                                                        |                                                    | degradation, i.e. <b>sediment</b> , <b>water column</b> , <b>air</b> or <b>biota</b> .                                                                                                                                                                                                                                    |
| <b>DREDGING GUIDELINES</b> | Numerical guidelines with primary emphasis on the concentrations of toxic materials in sediment to be dredged, with directions designed to minimize the adverse effects of sediment disposal.                                                                  | <b>FOOD CHAIN</b>                                  | The organization of biota in which organisms in higher trophic levels gain energy by consuming organisms at lower trophic levels; the dependence for food of organisms upon others in a series, beginning with bacteria and plants and ending with carnivores.                                                            |
| <b>DYNAMIC EQUILIBRIUM</b> | The result of fluctuations of the biological, chemical and physical components of the ecosystem within well defined bounds.                                                                                                                                    | <b>GOAL</b>                                        | An ideal, aim or objective towards which to strive; it may represent an ideal condition that is difficult, if not impossible to attain technically, sociologically, environmentally, or economically.                                                                                                                     |
| <b>ECOSYSTEM</b>           | The interacting complex of living organisms and their non-living environment; the biotic community and its abiotic environment.                                                                                                                                | <b>GREAT LAKES BASIN ECOSYSTEM</b>                 | The interacting components of air, land, water and living organisms, including humans, within the drainage basin of the St. Lawrence River at or upstream from the point at which this river becomes the international boundary between Canada and the United States (from Article 1 of the 1978 GLWQA).                  |
| <b>EFFLUENT</b>            | Waters discharged from facilities to either wastewater sewers or to surface waters.                                                                                                                                                                            | <b>GREAT LAKES WATER QUALITY AGREEMENT (GLWQA)</b> | A joint agreement between Canada and the United States which commits the two countries to restore and maintain the chemical, physical and biological integrity of the waters of the Great Lakes Basin Ecosystem (from Article 2 of the 1978 GLWQA). Originally signed in 1972 the Agreement was amended in 1978 and 1987. |
| <b>EPHEMEROPTERA</b>       | Invertebrates (e.g. mayflies) that live as adults only a very short time, but can dwell for several years as nymphs in sediment. Some species are indicative of relatively clean environmental conditions.                                                     | <b>GROUNDWATER</b>                                 | Water entrained and flowing below the surface which may supply water to wells and springs.                                                                                                                                                                                                                                |
| <b>EPILIMNION</b>          | The warm, upper layer of water in a lake that occurs during summer stratification, or layering of the open waters.                                                                                                                                             | <b>GUIDELINES</b>                                  | Any suggestion or rule that guides or directs; i.e. suggested criteria for programs or effluent limitations.                                                                                                                                                                                                              |
| <b>EROSION</b>             | The wearing away and transportation of soils, rocks and dissolved minerals from the land surface shorelines or river bottom by rainfall, running water, wave or current action.                                                                                | <b>HALF-LIFE</b>                                   | The period of time in which a substance loses half of its active characteristics (used specifically in radiological work); the amount of time required for the concentration of a pollutant to decrease to half of the original value through natural decay or decomposition.                                             |
| <b>EUTROPHICATION</b>      | The process of nutrient enrichment that causes high productivity and biomass in an aquatic ecosystem. Eutrophication can be a natural process or it can be a cultural process accelerated by an increase of nutrient loading to a waterbody by human activity. |                                                    |                                                                                                                                                                                                                                                                                                                           |
| <b>EXOTIC SPECIES</b>      | Species that are not native to the Great Lakes and have been intentionally or inadvertently introduced into the system, such as zebra mussel and purple loosestrife.                                                                                           |                                                    |                                                                                                                                                                                                                                                                                                                           |
| <b>FATE</b>                | As in the fate of a contaminant: the result of material deposition via transport, bioaccumulation, transformation and                                                                                                                                          |                                                    |                                                                                                                                                                                                                                                                                                                           |

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| HAZARDOUS SUBSTANCES     | Chemicals considered to be a threat to humans in the environment, including substances which (individually or in combination with other substances) can cause death, disease (including cancer), behavioural abnormalities, genetic mutations, physiological malfunctions or physical deformities.                  | LETHAL               | Causing death.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| HEPATIC                  | Of the liver.                                                                                                                                                                                                                                                                                                       | LIPOPHILIC           | Having a chemical affinity for fats, oils or other lipids, such as many trace organic contaminants.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| HEXACHLORO-<br>BENZENE   | A by-product of the chemical industry, created during the production of solvents and some pesticides. It is a persistent carcinogen.                                                                                                                                                                                | LITTORAL ZONE        | Productive shallow-water zone of lakes with light usually penetrating to the bottom; often occupied by rooted aquatic plants.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| HYDROLOGIC<br>CYCLE      | The natural cycle of water on earth, including precipitation as rain and snow, runoff from land, storage in groundwaters, lakes, streams, and oceans, and evaporation and transpiration (from plants) into the atmosphere.                                                                                          | LOADINGS             | Total mass of a substance added to a water body over a specified time; e.g. kilograms per year of phosphorus.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| HYPOLIMNION              | The cold, dense, lower layer of water in a lake that occurs during summer layering or stratification.                                                                                                                                                                                                               | MACROPHYTE           | Macroscopic plant life, larger than algae, found in bodies of water.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| INSECTICIDE              | Substances or a mixture of substances intended to destroy or repel insects.                                                                                                                                                                                                                                         | MACROZOO-<br>BENTHOS | Visible bottom dwelling animals, invertebrates. The distribution of macrozoobenthos in an aquatic ecosystem is often used as an index of the impacts of contamination on the system.                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| IN SITU                  | In place; occurring in nature.                                                                                                                                                                                                                                                                                      | MASS BALANCE         | An approach to evaluating the sources, transport and fate of contaminants entering a water system, as well as their effects on water quality. In a mass balance budget, the amounts of a substance entering the system less the quantity stored, transformed or degraded must equal the amount leaving the system. If inputs exceed outputs, substances, often pollutants, are accumulating and contaminant levels can rise. Once a mass balance budget has been established for a pollutant of concern, the long-term effects on water quality can be simulated by mathematical modelling and priorities can be set for research and remedial action. |
| INTERSTITIAL             | Of, forming, or occurring in interstices or pores between sediment particles; situated between the cellular components of an organ or structure.                                                                                                                                                                    | MERCURY              | Recognized as a dangerous substance for many years because it bioaccumulates and biomagnifies through the food chain, and can affect the central nervous system. It has entered the Great Lakes from a variety of industrial processes and natural sources.                                                                                                                                                                                                                                                                                                                                                                                            |
| INSTANTANEOUS<br>LOADING | A loading value calculated using either a single or a mean of concentration values multiplied by a single flow measurement (instantaneous flow). There is no attempt to calculate the total or mean loading which would require both concentration and flow measurements representing a full range of flow regimes. | METABOLITES          | Biodegraded chemical end products - the product of a bio-transformation process. Pollutants or natural substance produced from metabolic activity.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| LACUSTRINE               | Formed in, or growing in lakes.                                                                                                                                                                                                                                                                                     | MIREX                | A pesticide which has been found in significant quantities in Lake Ontario. It                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| LEACHATE                 | Materials that percolated through solids, soils, solid wastes and rock layers, that can enter the water column.                                                                                                                                                                                                     |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

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|                          | accumulates in the food chain, causes reproductive problems and cancer.                                                                                                                                                                                                                                                                                                                                                                                                                                                     | PERIPHYTON                    | Plants that live attached to underwater surfaces.                                                                                                                                                                                                                                                                      |
| MIXING ZONE              | <p>An area of water contiguous to a point source, where exceptions to water quality objectives and conditions otherwise applicable to the receiving water may be granted (OMOE 1984).</p> <p>For the purpose of point source recommendations: For non-persistent, non-bioaccumulative substances, the lesser of: 75 meters downstream from the discharge, or the distance to the nearest downstream intake or point source discharge. For persistent, bioaccumulative substances, zero (0) distance from the discharge.</p> | PERSISTENT<br>TOXIC SUBSTANCE | Any toxic substance with a long half-life in water or sediment. Can be defined as persisting for more than eight weeks.                                                                                                                                                                                                |
|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | PESTICIDE                     | Any substance used to kill plants, insects, fungi or other organisms; include herbicides, insecticides, algicides, fungicides.                                                                                                                                                                                         |
|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | PHENOLICS                     | Any of a number of compounds with the basic structure of phenol. Phenolics are produced during the coking of coal, the distillation of wood, the operation of gas works and oil refineries, from human and animal wastes, and the microbiological decomposition of organic matter. Phenols can cause tainting in fish. |
| MODELLING                | Mathematical simulation of actual conditions often used to predict the fate of nutrients, bacteria, or other chemicals in the ecosystem.                                                                                                                                                                                                                                                                                                                                                                                    | PHOTOSYNTHESIS                | A process occurring in the cells of green plants and some micro-organisms in which solar energy is transformed into stored chemical energy.                                                                                                                                                                            |
| MUTAGEN                  | Any substance or effect which alters genetic characteristics or produces an inheritable change in the genetic material.                                                                                                                                                                                                                                                                                                                                                                                                     | PHYTOPLANKTON                 | Minute, microscopic aquatic vegetative life; plant portion of the plankton (free floating aquatic plants); the plant community in marine and freshwater situations which floats free in the water and contains many species of algae and diatoms.                                                                      |
| MUTAGENICITY             | The ability of a substance to induce a change in genetic material which can be transmitted to progeny, or from one cell generation to another within an individual.                                                                                                                                                                                                                                                                                                                                                         | POINT SOURCE                  | A source of pollution that is distinct and identifiable, such as an outfall pipe from an industrial plant.                                                                                                                                                                                                             |
| NON-POINT SOURCE         | Source of pollution in which pollutants are discharged over a widespread area or from a number of small inputs rather than from distinct, identifiable sources. See also diffuse source.                                                                                                                                                                                                                                                                                                                                    | POLAR/<br>HYDROPHILIC         | Having an affinity for aqueous environment. Soluble in water.                                                                                                                                                                                                                                                          |
| NONPOLAR/<br>HYDROPHOBIC | Having an affinity for lipids rather than water. Having extremely low solubility in water, such as oil, grease, and many trace organic substances.                                                                                                                                                                                                                                                                                                                                                                          | POLLUTION (WATER)             | Anything causing or inducing objectionable conditions in any watercourse and adversely affecting the environment and use or uses to which the water thereof may be put.                                                                                                                                                |
| NUTRIENT                 | A chemical that is essential for the growth and development of organisms.                                                                                                                                                                                                                                                                                                                                                                                                                                                   | POLLUTION<br>PREVENTION       | The use of processes, practices or products that reduce or eliminate the generation of pollutants and waste at the source, including those that protect natural resources through conservation or more efficient utilization.                                                                                          |
| ORGANOCHLORINE           | Chlorinated hydrocarbons.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                               |                                                                                                                                                                                                                                                                                                                        |
| OXIC-ANOXIC              | <p>Oxic - oxygen present</p> <p>Anoxic - no oxygen present</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                               |                                                                                                                                                                                                                                                                                                                        |
| PATHOGEN                 | A disease - causing agent such as bacteria, viruses, and parasites.                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                               |                                                                                                                                                                                                                                                                                                                        |

|                     |                                                                                                                                                                                                         |                    |                                                                                                                                                                                                         |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| POLYCYCLIC          | Organic compound having three (3) or more ring structures may be the same or different; e.g. anthracene, naphthalene.                                                                                   | SEWER, STORM       | A municipal sewer for the collection and transmission of storm water runoff, land surface water and water from soil drainage not including any industrial wastes other than unpolluted cooling waters.  |
| POTABLE WATER       | Water suitable, on the basis of both health and aesthetic considerations, for drinking or cooking purposes.                                                                                             | SLUDGE             | Solids produced by wastewater (sewage) treatment facilities and some industrial processes.                                                                                                              |
| PRIMARY TREATMENT   | Mechanical removal of floating or settleable solids from wastewater.                                                                                                                                    | SOLUBILITY         | Degree to which a substance can be dissolved.                                                                                                                                                           |
| PUBLIC              | Any person, group, or organization.                                                                                                                                                                     | STABILITY          | Absence of or predictable fluctuations in populations; ability to withstand perturbations without large changes in community composition or function.                                                   |
| RADIONUCLIDE        | A radioactive substances.                                                                                                                                                                               | STANDARD           | (Water Quality) Regulatory limits concerning the concentration of chemical(s)/substance(s) permitted in effluent discharges and/or waterway(s). Standards are generally dependant on designated use(s). |
| RAW WATER           | Surface or groundwater that is available as a source of drinking water, but has not received any treatment.                                                                                             | STEADY STATE       | State in which rates of uptake and elimination of chemical/substance are equal - bioconcentration factors can be measured at steady state.                                                              |
| RESUSPENSION        | (of sediment) The remixing of sediment particles and pollutants back into the water by storms, currents, organisms and human activities such as dredging and shipping.                                  | STRATIFICATION     | (or layering) The tendency in deep lakes for distinct layers of water to form as a result of vertical change in temperature and therefore, in the density of water.                                     |
| RISK ASSESSMENT     | Process for estimating the likelihood that toxic response could take place if people or animals were exposed to certain concentrations of toxic chemical(s) over a given period of time.                | SUBACUTE           | Involving a stimulus whose duration is between acute and chronic.                                                                                                                                       |
| SECONDARY TREATMENT | Bacterial action on the waste remaining from primary treatment of sewage to decompose organic components of the waste.                                                                                  | SUB-LETHAL         | Involving a response to a stimulus below the level that causes death.                                                                                                                                   |
| SEDIMENT            | The fines or soils on the bottom of the river or lake.                                                                                                                                                  | SUSPENDED SEDIMENT | Particulate matter suspended in water.                                                                                                                                                                  |
| SEICHE              | An oscillation in water level from one end of a lake to another due to winds or atmospheric pressure. Most dramatic after an intense but local weather disturbance passes over one end of a large lake. | SYNERGISM          | The joint action of two or more substances, which is greater than the sum of the action of each of the individual substances. See also Antagonism.                                                      |
| SESSILE             | An animal that is attached to an object or is fixed in place (e.g. barnacles).                                                                                                                          | SYNERGISTIC        | Interactions of two or more substances or organisms producing a result such that the total effect is greater than the sum of the individual effects.                                                    |
| SEWER, SANITARY     | A municipal sewer for the collection and transmission of domestic, commercial and industrial wastes to treatment plants; not including land drainage or storm water runoff.                             |                    |                                                                                                                                                                                                         |

|                      |                                                                                                                                                                                                                                                                                                                                                             |                          |                                                                                                                                                                                                           |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SYNTHESIS            | The production of a substance by the union of elements or simpler compounds.                                                                                                                                                                                                                                                                                | TROPHIC LEVEL            | Functional classification of organisms in a community according to feeding relationships; the first trophic level includes green plants, the second level includes herbivores; etc.                       |
| TAXA                 | A group of similar organisms.                                                                                                                                                                                                                                                                                                                               |                          |                                                                                                                                                                                                           |
| TAXONOMY             | The process of identifying an organism by its structure.                                                                                                                                                                                                                                                                                                    | TROPHIC STATUS           | A measure of the biological productivity in a body of water. Aquatic ecosystems are characterized as oligotrophic (low productivity), mesotrophic (medium productivity) or eutrophic (high productivity). |
| TERATOGEN            | A substance that increases the incidence of birth defects.                                                                                                                                                                                                                                                                                                  |                          |                                                                                                                                                                                                           |
| TERATOGENICITY       | The ability of a substance to produce irreversible birth defects, or anatomical or functional disorders as a result of an effect on the developing embryo.                                                                                                                                                                                                  | TUBIFICID                | An aquatic oligochaete or sludge worm which is tolerant to organically enriched sediment and low oxygen concentration.                                                                                    |
| THERMOCLINE          | A layer of water in lakes separating cool hypolimnion (lower layer) from the epilimnion (surface layer).                                                                                                                                                                                                                                                    | TURBIDITY                | A measure of clarity in water.                                                                                                                                                                            |
| THRESHOLD            | The chemical concentration or dose that must be reached before a given reaction occurs.                                                                                                                                                                                                                                                                     | UBIQUITOUS               | Present, or seeming to be present, everywhere at the same time.                                                                                                                                           |
| TOXAPHENE            | An insecticide which was banned in 1983. It has been shown to be a carcinogen.                                                                                                                                                                                                                                                                              | UPTAKE                   | The transfer of a substance into an organism.                                                                                                                                                             |
| TOXIC SUBSTANCE      | As defined in the Great Lakes Agreement, any substance that can cause death, disease, behavioural abnormalities cancer, genetic mutations, physiological or reproductive malfunction or physical deformities in any organism or its offspring, or which can become poisonous after concentration in the food chain or in combination with other substances. | VIRTUAL ELIMINATION      | Cannot be measured (net loading) and does not have any bioaccumulative effect. For persistent, bioaccumulative toxics, no mixing zone will be recognized. No cross-media transfer is acceptable.          |
| TOXICANT             | Substance capable of producing adverse effect(s) in the ecosystem, resulting in injury, disfunction or even death.                                                                                                                                                                                                                                          | WATER QUALITY OBJECTIVES | Under the Great Lakes Water Quality Agreement, goals set by the Governments of Canada and the United States for protection of the uses of the Great Lakes.                                                |
| TOXICITY             | The quality of being toxic or poisonous.                                                                                                                                                                                                                                                                                                                    | WATER QUALITY STANDARD   | A criterion or objective for a specific water use that is incorporated into enforceable regulations.                                                                                                      |
| TROPHIC ACCUMULATION | Passing of a substance through a food chain such that each organisms retain all or a portion of the amount in its food and eventually acquires a higher concentration in its flesh than in its food. See also Biomagnification.                                                                                                                             | XENOBIOTIC               | Chemical not normally found in nature; i.e. manufactured chemical.                                                                                                                                        |
|                      |                                                                                                                                                                                                                                                                                                                                                             | ZERO DISCHARGE           | Total elimination of the parameter from the discharge (net loading).                                                                                                                                      |

## Acronyms

|          |                                                                                    |       |                                                                                                                     |
|----------|------------------------------------------------------------------------------------|-------|---------------------------------------------------------------------------------------------------------------------|
| AOC      | Area of Concern                                                                    | FSA   | Farm Service Agency                                                                                                 |
| ASCS     | Agricultural Stabilization and Conservation Service                                | GLPF  | Great Lakes Protection Fund                                                                                         |
| BAT      | Best Available Technology/Treatment                                                | GLCUF | Great Lakes Clean Up Fund                                                                                           |
| BATEA    | Best Available Technology/Treatment Economically Available                         | GLNPO | Great Lakes National Programs Office (EPA Region V)                                                                 |
| BMP      | Best Management Practices                                                          | GLWQA | Great Lakes Water Quality Agreement                                                                                 |
| BPAC     | Binational Public Advisory Council (used for RAP Accountability Committee as well) | HCB   | Hexachlorobenzene                                                                                                   |
| BTX/BTEX | Benzene, toluene, ethylbenzene, xylene                                             | HHW   | Household Hazardous Waste                                                                                           |
| CEPA     | Canadian Environmental Protection Act                                              | IJC   | International Joint Commission                                                                                      |
| COA      | Canada-Ontario Agreement Respecting Water Quality in the Great Lakes               | ILC   | Interactive Learning Centre                                                                                         |
| CDF      | Confined Disposal Facility                                                         | IADN  | Integrated Atmospheric Deposition Network                                                                           |
| CES      | Cooperative Extension Services                                                     | IPP   | Industrial Pretreatment Program                                                                                     |
| CSO      | Combined Sewer Overflow; combined storm and sanitary sewers                        | KETOX | A model consisting of a hydrodynamic and dispersion subprogram and a contaminant mass transport and fate subprogram |
| CURB     | Clean Up Rural Beaches                                                             | LEL   | Lowest Effect Level                                                                                                 |
| CWA      | Clean Water Act                                                                    | LIS   | Lambton Industrial Society                                                                                          |
| CWS      | Canadian Wildlife Service                                                          | LUST  | Leaking Underground Storage Tank                                                                                    |
| ESA      | Environmentally Sensitive Area                                                     | MDNR  | Michigan Department of Natural Resources                                                                            |
| EMPPL    | Effluent Monitoring Priority Pollutants List (OMOE)                                | MDPH  | Michigan Department of Public Health                                                                                |
| EPA      | (United States) Environmental Protection Agency                                    | MERA  | Michigan Environmental Response Act                                                                                 |
|          | Environmental Protection Act (Ontario)                                             | MIRIS | Michigan Resources Information System                                                                               |
| EROD     | Ethoxyresorufin-o-deethylase (Enzyme determination in fish)                        | MWHF  | Michigan Wildlife Habitat Foundation                                                                                |
| FPAC     | Farm Pollution Advisory Committee                                                  | MDA   | Michigan Department of Agriculture                                                                                  |
|          |                                                                                    | MISA  | Municipal-Industrial Strategy for Abatement                                                                         |
|          |                                                                                    | MDL   | Method Detection Limit                                                                                              |
|          |                                                                                    | NBS   | National Biological Service                                                                                         |



|        |                                                            |
|--------|------------------------------------------------------------|
| NPDES  | National Pollutant Discharge Elimination System            |
| NHL    | Natural Heritage League                                    |
| NAWMP  | North American Waterfowl Management Plan                   |
| NPS    | Non Point Source Control Program                           |
| NRCS   | Natural Resources Conservation Service                     |
| OMOEE  | Ontario Ministry of the Environment and Energy             |
| OMNR   | Ontario Ministry of Natural Resources                      |
| ODMP   | Ontario Drainage Management Program                        |
| OMAF   | Ontario Ministry of Agriculture and Food                   |
| OMAFRA | Ontario Ministry of Agriculture and Food and Rural Affairs |
| OSCIA  | Ontario Soil and Crop Improvement Program                  |
| OWRA   | Ontario Water Resources Act                                |
| ORBBP  | Ontario Rare Bird Breeding Program                         |
| OCS    | Octachlorostyrene                                          |
| PAH    | Polycyclic Aromatic Hydrocarbons                           |

|          |                                               |
|----------|-----------------------------------------------|
| PCB      | Polychlorinated biphenyls                     |
| PCE      | Perchloroethylene, tetrachloroethylene        |
| PERC     | Tetrachloroethylene                           |
| PSQG     | Provincial Sediment Quality Guidelines        |
| PIPP     | Pollution Index Prevention Plan               |
| PCP      | Pollution Control Planning Program            |
| ppb      | parts per billion                             |
| ppm      | parts per million                             |
| ppt      | parts per trillion                            |
| PPQ      | parts per quadrillion                         |
| PEAS     | Pollution Emergency Alert System              |
| RAP      | Remedial Action Plan                          |
| RIC      | RAP Implementation Committee                  |
| SEL      | Severe Effect Level                           |
| SCS      | Soil Conservation Service                     |
| SCP      | Stormwater Control Program                    |
| SDMP     | Storm Drain Marking Program                   |
| SAC      | Spills Action Centre                          |
| TKN      | Total Kjeldahl Nitrogen                       |
| TSS      | Total Suspended Solids                        |
| TCE      | Trichloroethylene                             |
| TEQ      | Toxic Equivalents                             |
| U.S. EPA | United States Environmental Protection Agency |
| USDA     | United States Department of Agriculture       |
| USACOE   | United States Army Corps of Engineers         |

USFWS     United States Fish and Wildlife Service

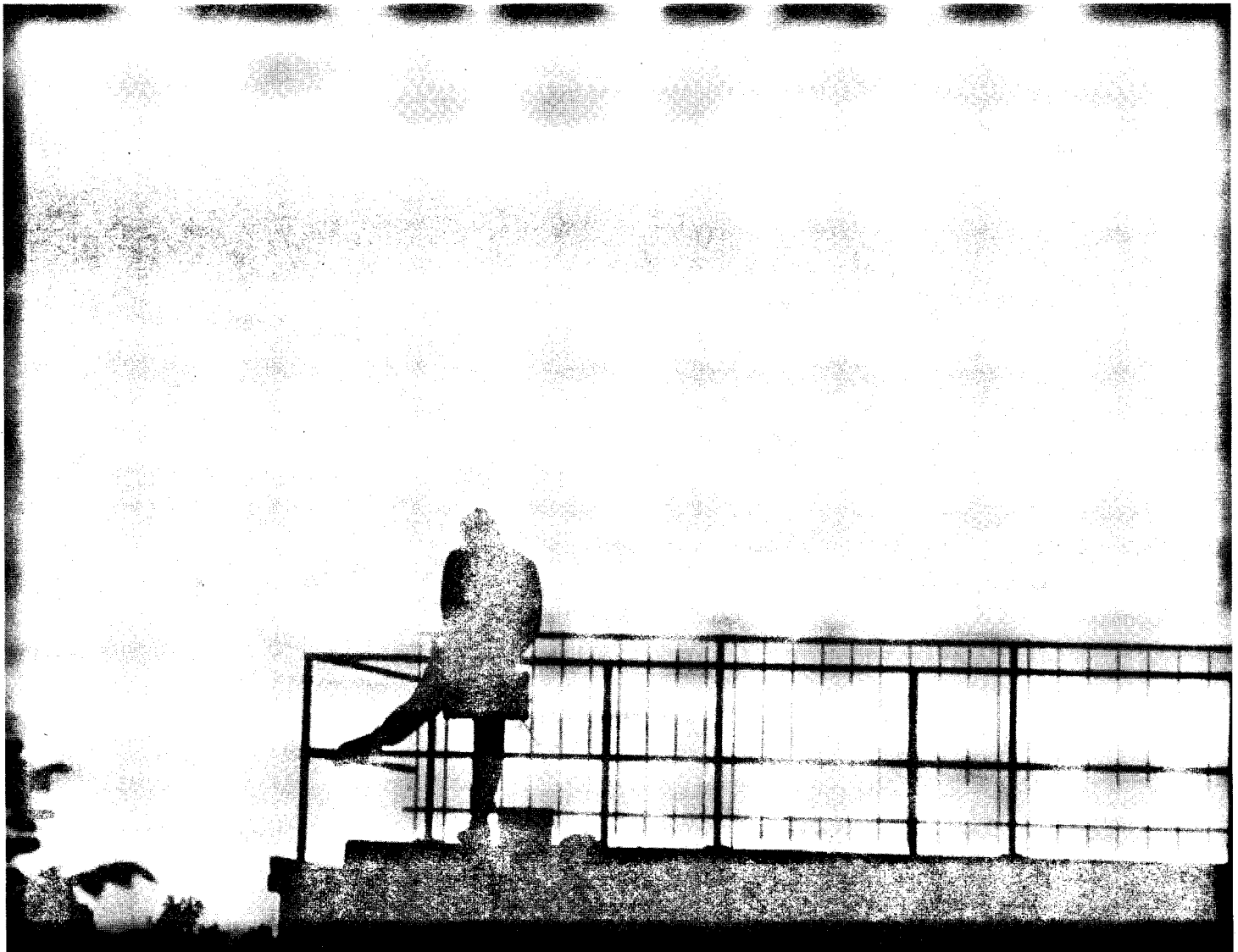
WPCP     Water Pollution Control Plant

WTP       Water Treatment Plant

WWTP     Waste Water Treatment Plant

WWSL     Waste Water Sludge Lagoon

WRITAR   Waste Reduction Institute for Training and  
Research





Canada Ontario



Michigan Department of Natural Resources  
Surface Water Quality Division



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